

United States Circuit Court of Appeals 1130

For the Ninth Circuit

MINERALS SEPARATION, LTD.,
ET AL,

Appellees,

vs.

BUTTE & SUPERIOR MINING
COMPANY,

Appellant.

Transcript of Record

Volume 7

(Pages 3541 to 4212, Inclusive)

UPON APPEAL FROM THE UNITED STATES
DISTRICT COURT FOR THE DISTRICT
OF MONTANA

Prof. Arthur Fay Taggart.

these deaths and gets an average expectation of life for a man of a given age, ~~and~~ and on that average enormous sums of money are invested. Now here is a set of data with variations certainly not so great as in the case of the actuary; and while it is impossible for the mind to grasp the whole situation of these detailed figures, and all you can do is to pick exceptions—The general trend of results is convincingly shown by this curve representing the average.

THE COURT: I think I understand what the witness is endeavoring to arrive at now. I will have to get out my old algebra and brush up a little.

MR. SCOTT: Professor, you may mark that diagram on the other side so as to keep it in the record.

Diagram 24 of Professor Taggart, admitted in evidence marked DEFENDANT'S EXHIBIT No. 200.

Q. 14. BY MR. GARRISON: Are all these charts the same?

A. One half of them show the relation of dilution to oil, and the other half show the relation of the amount of sulphide to oil.

Q. 15. But they all proceed on the same principle?

A. Yes, sir.

MR. GARRISON: I don't see why it is necessary to go into the details of those things.

Q. 16. THE COURT: This line which you curve through there, that is done to give the detail of these things, and then you connect them up?

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A. That is a chronological curve. Now, I have some of those same data presented chronologically, and there you get that variation; but if you desire, for instance, in this particular chart, the average curve, we proceed in exactly the same way that I proceeded here, and the average curve would come in in some such fashion as this. This would be a much more difficult problem, because the average curve is practically on a straight line, and we would have to fool around a long time to get the particular curve line.

THE COURT: Well, I think it is 5 o'clock. If there is any way you can facilitate the examination by these other gentlemen, you might do it. You expect to put in each one of these with an explanation, I suppose?

MR. SCOTT: That is our intention, yes, sir.

Adjournment until Wednesday, May 2nd, at 10 a. m.

Wednesday, May 2nd, 1917, 10 o'clock a. m.


PROF. TAGGART on the stand.

DIRECT EXAMINATION Resumed
BY MR. SCOTT:

Q. 17. I think you were explaining the first graph when we closed—the first one you mentioned. I mean

P. 3543, L. 12, " the same percentage of water in the feed ;
and " after " are "

P. 3543, L. 14, insert " the pounds of oil per ton of feed
and that the same variation as before holds, namely," after
" namely,"



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used, at the Arthur plant of the Utah Copper Company, and I have shown that, as the percentage of dilution of the feed increased—that is, as the percentage of water in the feed increased, other factors remaining approximately constant, that the pounds of oil necessary to get a satisfactory recovery increased also.

Now, I have some other curves. Here, for instance, is a curve of the Utah Copper Company, Magna plant, the curve No. 3 of the Utah Copper Company, Magna plant. You will notice there again that the ordinates, or the values of the vertical scale are ^{the} abscissae, or the values of the horizontal scale are the same, namely, ^{that} the amount of oil necessary increases as the amount of water in the feed increases.

Again in curve No. 1 of the Utah Copper Company, Magna plant, is shown the same relation between the percentage of water in the feed and the pounds of oil necessary per ton of feed.

Now, at the plant of the Ray Consolidated Copper Company at Hayden, we have exactly the same relation between the percentage of water in the feed and the pounds of oil per ton.

Here is a curve showing the work of the Butte & Superior Mining Company, plotted in exactly the same way; the percentage of water in the feed, as the vertical scale, increasing upward; the pounds of oil per ton of feed, as the horizontal scale, increasing to

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from original records of flotation slime vanner tailings plant for periods of ten days for the year 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 203.

MR. SCOTT: I now offer the graph for the Ray Consolidated Copper Company, showing the relation of pounds of oil per ton of feed to the percentage of dilution of feed, the same being based on data from the original records of vanner concentrate flotation plant for ten day periods during the year 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 204.

MR. SCOTT: I now offer graph for the Chino Copper Company, Hurley plant, showing the relation of pounds of oil used per ton of feed to the percentage of water in the feed, the same being based on data taken from the original records of the vanner concentrate plant, month of November, 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 205.

MR. SCOTT: I offer a graph for the Butte & Superior Mining Company, showing the relation of pounds of oil per ton of flotation feed to the percentage of water in the feed, the same being based on data compiled from the original flotation records, for the month of November, 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 206.

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Q. 20. Have you compiled similar graphs representing the relation of the amount of oil to the amount of sulphides in the feed?

A. I have.

Q. 21. Will you produce them?

A. Now, the first one that I would like to call attention to is that No. 2 of the Utah Copper Company, in which the percentage of total sulphides in the feed is plotted as the vertical scale and the pounds of oil necessary per ton of feed is plotted as the horizontal scale. The curve had been drawn—or the straight line has been drawn, through these points in the way that was explained yesterday, and in the same way that the straight line was drawn of the relation between dilution and pounds of oil necessary. And the same relation shows, that is, that as you increase the richness of the feed to the flotation plant, other conditions remaining approximately constant, that the amount of oil necessarily increases. I have here also a curve plotted from the records of the Butte & Superior Mining Company, showing the same relation between the percent of zinc sulphide in the feed and the pounds of oil necessary.

I have also a curve of the Chino Copper Company, showing the same relation to exist between the percent. of sulphides in the feed and the pounds of oil used per ton. It will be noticed on this curve that at the right hand side there are four points which are apparently decidedly erratic; that is, they use a larger amount of oil than is apparently necessary for the

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percentage of sulphide in the feed on those days; but on those four days the average dilution of the feed was higher than the average dilution on the other days; in other words there the dilution came in and raised the amount of oil necessary. Had the dilution been the same as it was, those four points would move right back onto or very near the straight line which has been put through as representing the relation.

I have next a curve showing the relation between the percent of total copper and iron and the pounds of oil used per ton of feed at the Ray Consolidated Copper Company. This curve was drawn to show the relation between the metal, rather than the sulphide, because the sulphide of course increases with the metal. Changing these figures to sulphide, would merely mean changing the vertical scale, but would not alter the slope of the curve, and it was rather more easy to calculate this thing, and not so many assumptions had to be made in counting the total copper and iron—no assumptions, in fact, had to be made in plotting those figures, while if we had attempted to change these figures into sulphide, some assumptions would have had to be made.

A definite relation exists between the total copper and iron and the percent of total sulphides of copper and iron, and the same relation will hold between the percent. of total sulphides of copper and iron and pounds of oil per ton of feed, and the amount of total copper and iron, in relation to pounds of oil per ton

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of feed. $1\frac{1}{2}$ still shows the tendency, that the amount of oil increases as the percentage of sulphide in the ore increases.

The same remarks hold in regard to the curve marked No. 3, of the Ray Consolidated Copper Company. I am again showing here the percent. of total copper and iron as against the pounds of oil per ton, this being from the slime vanner tailing plant, while the preceding one was from the concentration plant. Here the slope of the curve is very decided, and exhibits again this relation.

Now, in relation to these last two curves, I would like to call the court's attention to another confirmation of our idea—or of the fact that the amount of oil necessary for efficient concentration increases as the percent. of sulphide in the ore increased.

In the two tables which were presented by the Ray Consolidated Copper Company plant, we have the data^a given concerning the vanner concentrate retreatment plant and the slime vanner tailing plant. In the case of the slime vanner tailing plant the pounds of oil used per ton range from 1.82 as a maximum to .63, if I read this table correctly, as a minimum; in other words, somewhere in the neighborhood of one pound per ton as an average minimum efficient quantity of oil. The total percentage of copper and iron in the feed ranges in 2%—I think it is not necessary to pick out the maximum and minimum pounds of it, but all these figures are within a range of 2%; in other words, for one pound of oil that is used, the feed contains

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about 2% of total copper and iron sulphide. Now, in the concentrate retreatment plant, the same kind of oil is used. The sulphides are of course the same sulphides, and the gangue present is of course the same gangue; in other words, here we have all conditions the same, except the amount of sulphide present in the feed and the amount of oil used.

In the vanner concentrate retreatment plant the total percent of copper and iron ranges from approximately ten to fourteen percent., and the amounts of oils necessary range from about 2.7 up to about 4 pounds; in other words, there, with all the conditions the same except these two variables, percentage of sulphide and pounds of oil per ton, we have this increase in the pounds of oil as the percentage of the sulphide increases.

It is necessary in any such comparison as this that the kind of oil and the kind of sulphide compared be kept the same. It is possible, as we all know, to treat Butte & Superior ore with one, two or three pounds of oil per ton. There is somewhere in the neighborhood of twenty per cent of sulphide in Butte & Superior ore. And, if we go down to the Utah Copper Company, where the feed in the slime treatment plant runs down in the neighborhood of perhaps one to two per cent sulphide in the feed, the minimum efficient quantity of oil there, certain kinds of oil, will be in the neighborhood of one or two pounds per ton, which would look like a contradiction; but, if the same oil and the same sulphide are used to-

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gether, that are shown in this Hayden plant, between the slime vanner plant and the concentrate retreatment plant, and in the relation shown in the curves, it is necessary then, other things being constant, to increase the quantity of oil as the percentage of sulphide increases.

MR. SCOTT: If you will hand me copies of those last graphs showing the relation of oil to sulphide, I would like to offer them so as not to get them confused.

I offer the graph for the Utah Copper Company, Magna plant, showing the relation between pounds of new oil per ton of original feed and percentage of sulphide in the feed, the same being based on data taken from the records of the year 1916, January 1 to December 24, inclusive.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 207.

MR. SCOTT: I offer the graph for the Butte & Superior Mining Company showing the relation between pounds of oil used per ton of flotation feed and percentage of zinc sulphide in the feed to flotation plant, same being based on data compiled from original records, month of November, 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 208.

MR. SCOTT: I offer the graph for the Chino Copper Company flotation plant showing the relation be-

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tween pounds of oil used per ton of feed and percent of total sulphide in the feed, the same being based on data taken from the original records of vanner concentrate flotation plant, month of November, 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 209.

MR. SCOTT: I offer the graph for the Ray Consolidated Copper Company showing the relation of pounds of oil per ton of feed to the percentage of total copper and iron in the feed, the same being based on data taken from the original record of flotation slime vanner tailings plant, for the periods of ten days each during the year 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 210.

MR. SCOTT: I offer the graph for the Ray Consolidated Copper Company, Hayden plant, showing the relation between the pounds of oil used per ton of feed and the per cent total copper and iron, the same being based on data taken from original records of the vanner concentrate flotation plant for the ten day periods during the year 1916.

Graph admitted in evidence and marked DEFENDANT'S EXHIBIT 211.

MR. SCOTT: One question I would like to ask you.

Q. 22. In the first place, the dots are located on

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the chart, their position upward from the base line being determined by the dilution or amount of sulphide, as the case may be; and their position to the right of the other base line being determined by the amount of oil used?

A. That is right.

Q. 23. And the locating of the curve afterwards is a matter of mathematical computation, after an accepted formula?

A. That is right.

Q. 24. Have you ever conducted any operations yourself using amounts of oil running into high percentages?

A. I directed a couple of tests at the plant of the Utah Copper Company recently concerning which I have the data here.

Q. 25. At which plant was that?

A. At the Arthur plant.

Q. 26. Will you just describe that operation?

A. The first one of these tests was in one of the regular Janney mechanical machines arranged 13 cells in series, taking the full feed, with no circulation.

MR. WILLIAMS: I think, if your honor pleases, that this is an *exparte* experiment.

MR. SCOTT: I will have Mr. Frank Janney testify that he invited your representatives to see this test but they didn't come. It was during the time that your representatives visited Salt Lake.

MR. WILLIAMS: I know nothing about it; counsel knows nothing about it.

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MR. SCOTT: They were invited to attend.

MR. WILLIAMS: Apparently here is something that was conducted at a plant while our representatives were present?

THE WITNESS: No, no.

MR. SCOTT: No.

MR. WILLIAMS: I don't really know what it is about, but it seems to me here is an effort to put in an exparte experiment.

MR. SCOTT: The offer was made to perform these tests in their presence while they were there, at the most opportune time to do it, for them.

MR. WILLIAMS: I reserve the right to object until I find out what is all about.

A. This is a test run at the plant of the Utah Copper Company, the Arthur plant, on their machine called No. 1, which was a 13 cell Janney mechanical machine with two emulsifiers at the head of the machine, in the plant retreating vanner concentrates. The full normal feed of this particular machine was taken during the period of the test, and the middlings of the machine were not circulated. The duration of the test was one hour, and I made previous observations before starting this test to determine that representative results could be obtained in a run of one hour's duration—not the best results, but representative results. I have here some extra copies of this which I can distribute if you wish before the discussion begins. It will be noted that the heads or the feed to the machine ran 4.7 per cent total copper; that the feed

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contained 42.26 per cent solid; the tailings contained .8% copper; the concentrates contained 14.15% copper, 10.5 per cent iron, 52.50 per cent insoluble. The ratio of concentration was 3.42. The per cent of indicated extraction on the copper was 87.95; the pounds of oil added per ton 21.78; the reagent used was the so-called calura of the Utah Copper Company plant and the oils used were the viscous heavy oils of the standard Utah Copper Company oil mixture. In other words, they were a part of the oil mixture used at the Utah Copper Company which is labeled under certain circumstances as inert. The interesting part of the test then being that, using these so-called inert oils, which it has sometimes been assumed are added purely for the purpose of cheaply bulking the amount of oil used up to more than twenty pounds per ton, that even on so short a test as this it was possible to push the recovery up to 87.95. I have also here the record of another test that was made—

MR. SCOTT: I will offer this report produced by the witness of this operation just described by him.

MR. WILLIAMS: I object to the testimony of the witness in regard to this and to the report itself for the reason that it is shown to represent an experimental operation conducted at a plant at a time when our representatives were there and not conducted in their presence nor with any opportunity for them to observe and check up the results. It seems to me that there should be a limit placed upon this kind of experimenting, and that when the circumstances are such that

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it could have reasonably been conducted with opportunities for inspection and it does not appear that there was any effort to so conduct it, that the testimony should be rejected as not worthy of consideration by this court or any of the courts that may follow it.

THE COURT: Well, does it appear that your representatives were there?

MR. WILLIAMS: Yes, and so far as we know it appears that they were ^{very} busy taking specimens, and couldn't give the matter any attention. There is no evidence of that either at all, no. It does not appear in evidence that our representatives were there. Nothing has appeared. It is all statements.

THE COURT: You are making an objection and stating facts that do not appear here.

MR. WILLIAMS: Then I say here is a test which—

THE COURT: Well, the particulars will all come out eventually, and for the sake of the record the court will allow this testimony to be introduced. He has already testified to it orally. If the circumstances are such that it should not receive any consideration the court will give it none. The objection will be overruled.

Report admitted in evidence and marked DEFENDANT'S EXHIBIT 212.

THE WITNESS: I have here another test that was run at the same time as the one just testified to. I will give you copies of the description.

Q. 27. This test represents ^{ed} upon this memorandum

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you have just produced was performed under your supervision, was it?

A. Yes.

Q. 28. And what plant was it performed in, and what machine?

A. At the Arthur plant of the Utah Copper Company, on the same machine as the previous test and on the same feed; that is, the vanner concentrate, using the full 13 cells of the machine, the full normal feed to the particular machine, and the middlings not circulated.

Q. 29. The material simply went through the machine from one end to the other?

A. Yes, and contrary to the usual practice in the plant, the middlings were thrown directly in with the concentrates, rather than being sent back to the Dorr thickeners and back to the plant for retreatment.

Q. 30. What was the reason?

A. In order to prevent building up an oil circulation in the middlings and consequently getting different results from those that would be indicated with the exact quantity of oil that we were adding.

Q. 31. In other words, giving back the exact quantity of oil you added, without increasing it through local circulation?

A. Yes, sir. In this particular test the feed came in at the rate of 460 tons per 24 hours, the copper in the feed being 4.875%, the feed containing about 42% of solid matter. The tailings ran .462% of copper, the concentrate 13.3% of copper, 10.2% of iron

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and 39.2% insoluble. The ratio of concentration was 2.91, and the percentage of indicated extraction, based on the copper, 93.78. The reagent used was the so-called Calura, and the oil was the usual oil mixture of the Utah Copper Company Arthur plant when treating vanner concentrates, being 59% smelter fuel and 30% Jones oil—those are the heavy viscous oils—10% American Creosote No. 2, and 1% Varyan pine.

The interesting part of this experiment or test is the amount of oil that was added per ton of ore, which was 249.83 lbs. The concentrates contained, by analysis, 491 lbs. of oil per ton, and the tailings contained by analysis 23.16 lbs. of oil per ton. During the conduct of the test I made continual observations as to the distribution of the froth on the cells and as to the character of the tailings from the machine. When this test was started the machine had been run for a considerable length of time previously without any oil being added, and the froth had died down on the surface of the cells until there remained nothing but occasional scattered bubbles on each and all of the cells. Very shortly—ten minutes after the oil was added, froth was appearing, a rather voluminous oily appearing froth was on the cells down to about No. 7. As the test progressed, the froth, a voluminous working froth, appeared on the cells on down in the machine until at the end of the test froth was being removed in considerable quantities, and when I speak of froth I am making a distinction as between froth and the stray bubbles that are present

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under ordinary operations on the later cells—Froth was appearing the full length of the machine. At the same time that that happened I had a ^asample taken of the tailing and examined the sample very carefully, first before any vanning had been done, and then I vanned down slowly, watching for oil in the tailing, and watching also most particularly for the so-called Cattermole granules which are agglomerates of sulphide particles. There was a large amount, as is obvious, of course, from the analysis, of oil in the tailing. I took the different particles of oil between my fingers and worked them over—There was no pretense or no appearance whatsoever of granulation and balling up into small agglomerates—but to assure myself that there was not any prejudicial amount of sulphide in this oil, I took the particles between my fingers and rubbed my fingers together and got no more grit from the oil than one will necessarily get if he takes some muddy water between his fingers; in other words, there was no semblance whatsoever of the Cattermole effect in the tailings of the machine.

The percentage of oil in the tailings assures us that in each successive cell throughout the machine there was contained more than 20 pounds of ore per ton of feed to that particular cell, and the frothing, which differed only in apparent oiliness throughout the machine—The first cell was of course the most oily appearing—and as we moved down the cells, the oily appearance decreased. Apart from that, and

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apart also from the volume, there was no difference whatsoever in the character of the froth—I should perhaps say structure of the froth rather than character; there was some difference in the character if the richness should be so described.

Q. 32. Will you compare the froth which you have just described in the matter of structure with that which you have seen when the apparatus is operating on less than 1% of oil?

A. The structure was just the same of course; the bubbles consisted of films of contaminated water, containing solid matter.

MR. SCOTT: I offer the report produced by the witness of the operations just described by him at the Arthur plant of the Utah Copper Company. I may state that we will produce Mr. Janney, as I said before, who will testify that he invited the representative of the plaintiff to see a test ^{such} as described by the witness~~es~~, but, in order to remove all misunderstanding, we now offer to repeat this test for their benefit and in their presence, with access to all of the details and every opportunity to check it.

Report of test No. 2 admitted in evidence marked DEFENDANT'S EXHIBIT No. 213.

MR. WILLIAMS: We accept the offer of the defendant, because that seems to be the only solution. These are very interesting and perhaps instructive tests, if we can find out all about them.

MR. SCOTT: We have a witness who will testify

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to still another test, and we extend our invitation to cover that also, a test at the same plant, or anyway in the same town. I think it is at the same plant.

THE WITNESS: Yes, at the same plant.

MR. WILLIAMS: So that can all be done in one trip?

MR. SCOTT: Yes. You may cross examine.

MR. WILLIAMS: I think as far as these particular tests are concerned, your honor, that the right to cross examination had better be deferred until we have seen them repeated and know about them.

THE COURT: I am beginning to think that this case shows no prospect of ever ending, if witnesses are called and recalled and transferred to Utah to make tests and come back again.

MR. SCOTT: Maybe they could do that over Sunday, your honor, so as not to delay matters.

THE COURT: Proceed.

MR. GARRISON: Your honor is not going to make us cross examine on ~~these~~^{these} tests held not in our presence?

THE COURT: Is this the way patent cases are usually tried?

MR. GARRISON: I think not, your honor.

MR. SCOTT: I only extend this invitation as to this particular test in the interest of peace. Mr. Janney invited these representatives to see this, and they said they could not stay over to see it.

MR. KREMER: Wasn't Professor Fulton your representative?

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MR. WILLIAMS: Professor Fulton was one of our representatives.

MR. KREMER: He was invited to attend this test.

MR. WILLIAMS: Just about the time he was going to take his train.

MR. KREMER: I don't know anything about his train; he was invited.

MR. GARRISON: That is not the important matter. Professor Fulton had no authority to attend this test. Counsel governed these matters, and he had to get back to be present the next morning in court. Now, to be fair and to have all the testimony brought in that ought to be brought in, I assume that these tests are relevant and important points in this case. If not, they should not be admitted to it at all. They are, however, self-serving declarations by these gentlemen who get up and qualify as experts here, but whether they have knowledge of what they are going to do—They bring in things written on a paper which are utterly un-cross-examinable by us, and they produce what they assume to be proper testimony. I conceive that nothing could be less productive of fairness and nothing could put the other side at a greater disadvantage than we are put in this matter.

It of course deserves no special credit on our side that we have not been captious. We realize that this case is of great importance; that in its various aspects it has been to the Supreme Court of the United States and before other various high courts of jus-

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tice in this country. We realize that your honor does not intend to exclude any evidence which, by any possibility could have any bearing—any proper bearing on the issues in this case, and with that view we sympathize; we do not want this case tried so that any court of law which passes upon it has any doubt—

THE COURT: Is it your opinion that such evidence should not have been admitted?

MR. GARRISON: Should not have been admitted at all, sir. I should like to speak of that ~~if~~ it was not a ruling that your honor has already made.

THE COURT: Well, have you not said that you intend to put in some test of this kind?

MR. GARRISON: No, sir; we do not propose to put in any test not made in the presence of the court, do we, Mr. Williams?

MR. WILLIAMS: We propose to put in none that were not made in the presence of the opposing parties, and as far as we know we do not propose to put in any tests except those made in the presence of the court.

THE COURT: These tests and experiments close to the beginning of a trial, I imagine are not entitled to very much weight. I think there is a case in the Supreme Court where they virtually intimated that they should not be accepted, especially if they were made out of the presence of the other party, and samples were not taken.

MR. GARRISON: Yes, sir; I was just going to call your honor's attention to that.

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THE COURT: And I think that the court should say something about it, for fear they should be held competent further along the line.

MR. GARRISON: Exactly; if they are incompetent we are absolutely confronted with these figures, not knowing anything about them, or what the ingredients might have been or anything, and we simply can not cross examine about them.

THE COURT: The court has admitted these things with the statement that if the court thinks it is not entitled to consideration, it will get none. But I may make up my mind later on that these things are entitled to consideration. The plaintiff, however, can not say the court thinks them entitled to consideration, and I can see how that would be.

MR. GARRISON: The first case that I ever tried, I relied upon the first point and thought that I was perfectly safe on the second point. The court held with me on my first point and against me on my second point, and threw me out of court, and I have been rather wary ever since. We think these tests should be excluded; they were performed out of our presence and without our being advised of what was done. If your honor is willing to adjourn court sufficiently long for them to conduct tests in our presence at certain places, we will submit to that ruling, and of course, I want to suggest very earnestly to your honor the impropriety of permitting evidence of this kind, which there is no way for us to check.

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THE COURT: On what theory do you offer it, Mr. Scott?

MR. SCOTT: It is the universal practice in patent cases to hold that, whether an experiment is *exparte* or *inter-parte* goes to its credibility only, and has nothing to do with its admissibility; and where the other side are invited to attend, and either do or ^{not}, even the element of credibility is removed from the situation altogether.

THE COURT: The invitation to a mere employe four or five hundred miles away would be hardly sufficient.

MR. SCOTT: They were there for the express purpose of investigating the operation of this plant.

THE COURT: Well, it stands in the record, and you will be given an opportunity to meet it. If you can not meet it, of course the court takes that into consideration, but certainly there must be a limit. You are not to keep the court waiting while different sets of witnesses go from here to Utah to carry on tests and report back about them, and the other side must come back and check them up. We will never get through here at all at that rate. The year's work of the court will be dislocated completely. I appreciate that you must have all the time necessary to try this case, but that does not mean that you may have all the time that you think is necessary. There is quite a distinction there.

MR. KREMER: The offer was made, and the objection was interposed that they did not have the

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opportunity to check the test, and we made the offer to repeat it, and they accepted it.

THE COURT: Well, the court has something to say about that; it has not surrendered the entire control of this case to counsel.

MR. KREMER: I appreciate that, but they have about 14 men whose names were presented here, any one of whom could go there and inspect it. I don't think it is going to delay the trial at all.

MR. GARRISON: I would like your honor to rule upon the question of the competency. This witness has not shown that he knows how much tonnage was put into the machine or how much oil or how much calura, or anything else; he has not qualified as a metallurgist; and yet he comes here in person and offers testimony which covers a plant half as big as this court house, and pretends to know just what took place at every point in that plant,—and if he does not know, his testimony is not competent—

THE COURT: What are the qualifications which this witness gave; it has been some time ago.

MR. GARRISON: He has not qualified as a metallurgist. He tells the amounts of the heads and tails and tonnage; he tells the amount of acids and insolubles and all that in his own person. He is an entire concentration of the apparatus of that plant upon this most critical day. Now, if that kind of testimony is admissible, the rules heretofore governing the courts upon the character of evidence that can be given in court are all wiped out. This is the rankest hearsay.

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and yet we are met with his bald statement that, in respect to very important points in this case he is going to lay down certain dicta, which, unfortunately for us, cross examination can only cause him to reiterate and emphasize.

THE WITNESS: I think I can qualify, your honor, in the ways that the gentleman questions.

MR. SCOTT: The witness has already qualified.

THE WITNESS: I also observed the weighing—

MR. GARRISON: One moment, please. I am not arguing this case with the witness; I am arguing it with your honor.

THE COURT: Well, I allowed the witness to testify at length as to what were his qualifications originally.

MR. SCOTT: He testified to having an education in mining engineering at Stanford University, to several years' practical experience in his profession—

THE COURT: These facts that he is testifying about now appear, and if he is not qualified to testify to those, it will be enough to show on cross examination whether he is qualified or not.

MR. GARRISON: I understood his testimony to be that he had been at plants before flotation was introduced.

THE COURT: With reference to the fact, does he know how much oil and other things were used, and as to the analysis, etc.? Both parties have allowed that to go in from the beginning. I don't know about this. You can develop it if you can.

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CROSS EXAMINATION,

BY MR. WILLIAMS:

X-Q. 33. What knowledge have you as to the feed that entered the flotation plant at the operation which you called test No. 1?

A. As to what particular characteristic of the feed, Mr. Williams?

X-Q. 33-A. What knowledge have you of that feed—not information, but knowledge?

A. As to what particular characteristic?

X-Q. 33-B. Well, what do you know about it.

THE COURT: He is proceeding to tell.

A. I know as to the quantity in so far as the tonnage sample, which is the ordinary method of determining the quantity, will tell. I watched the tonnage sample taken; I watched the weights taken off the scales, I watched the timing.

X-Q. 34. Then what was done to those tonnage samples afterwards in your presence?

A. The tonnage samples were dumped from the pan on the scales to the launder underneath the scales.

X-Q. 35. Well, then, what further did you see being done with that tonnage sample.

A. Nothing.

X-Q. 36. And yet you come here and say that the headings contained a certain proportion of solid, a certain amount of sulphide, and a certain amount of carbon—is that what you mean there?

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A. No, sir.

Q. 37. What is that "carb"?

A. That stands for carbonate.

X-Q. 38. Now, where did you get all this knowledge from?

A. That was reported from the assay office.

X-Q. 39. Did the assay office tell you what the condition of the water was in which that ore was diffused?

A. As to what particular characteristic?

X-Q. 40. Was it pure water or was it water charged with a modifying agent?

A. It was water containing a very small quantity of contaminant in the shape of—which was determined—in the shape of oil. The Dorr tanks—or at least this machine had been run without return to the Dorr tanks for several days preceding this test at my direction in order that the amount of contaminant in the pulp going to the machine could be reduced as greatly as it was possible to reduce it. It is not possible to get it down so that there yet remained no trace of oil; but as I recollect, and I can produce assays if you so desire, the amount of oil in this feed coming to the machine was down in the neighborhood of one pound per ton of feed by assay. And I considered that as I was going to add somewhat more than 250 pounds of oil—

X-Q. 41. No, we are on No. 1.

A. I see. As I was going to add somewhat more than twenty pounds of oil per ton to the feed that that wouldn't make any difference.

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X-Q. 42. You think, having in mind the sequence of the operation and observing that the twelve and a half per cent—we will take it as twelve and a half per cent round figures?

A. Yes, sir.

X-Q. 43. Now, the twelve and a half per cent operation was carried on first?

A. Yes, sir.

X-Q. 44. From 7:45 to 8:45 p. m.

A. Yes.

X-Q. 45. And this determination that you speak of and that you have not given us of the pound of oil in the feed water, that relates to that first operation, does it not?

A. And relates also to the second. We were sampling along in there right straight ahead in order to find out—to try to find out when that tank was ever going to get down to a point where it wasn't carrying a small amount of contaminant.

X-Q. 46. Immediately after you did your twelve and a half per cent operation which loaded up your machine with oil, you did this 1.08 per cent operation?

A. Yes, sir.

X-Q. 47. Which followed it by some forty-five minutes?

A. Forty-five minutes, yes, sir.

X-Q. 48. What provisions did you observe between these two operations to remove that contaminated amount of oil that had flowed through the plant at the end of the operation which is marked test No. 2, and which ended at 8:45 p. m.?

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A. We stopped feeding oil to the machine, flooded the machine with water and scraped froth off until no more froth appeared than scattered bubbles, throughout the full length of the machine, and then having brought the water down again to the point that the cells were not overflowing as to allow an opportunity for the froth to collect if it would collect, we ran machines in that way and found that no froth collected. In other words, there was not enough oil present in the feed, this small amount which I have mentioned shown by the assay, to cause any frothing or collection.

X-Q. 49. That is to say there was not enough there to form any froth until you added your 1.08 per cent of the heavy oils and then it formed a froth?

A. Well, of course that is a way to put the question. I will answer it by saying that there was not enough there to form a froth; that there was not enough there to form a froth when small quantities of the mixed oil was added, because such tests were made at another period of my stay down there to determine whether 1.6 pounds of this mixture would do any work at all, and we discovered that it would not, and so there was not enough oil there even to do any work when this final mixture was added. Consequently I stand on this test marked No. 1, and on the statement that the effective part of the collecting agents and frothing agents present in that test was the 21.78 pounds of oil consisting of 66% smelter fuel and 34% Jones.

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X-Q. 50. That is to say, in your opinion, all the work resulted from 1.08 per cent of the heavy oils and nothing resulted from the presence of something over a pound per ton of the dissolved frothing agent?

A. Yes, sir.

X-Q. 51. And the test that you have numbered No. 2 was the first test that you made?

A. Yes, sir.

X-Q. 52. And the test that you have numbered No. 1 was the second test that you made?

A. Yes, sir.

X-Q. 53. Three quarters of an hour afterwards in the same machine?

A. These are renumbered for the convenience of the stenographer. The original number of these tests, if you would like to have them, were—the test which is No. 1 was No. 10, and the test which is No. 2 was No. 5. I have the data here in my notebook if you would like to see it.

X-Q. 54. That is to say you made some eight other tests?

A. Yes, sir.

X-Q. 55. Which you did not think it was worth while to bring here?

A. No, sir; we considered that we would be encumbering the record with repetition. There were quite a few data presented in the early days—I mean of the testimony, which I asked to see, as I wanted to see how these things were working, and we went down and ran a series of tests, which were purely confirma-

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tory, as it were, of tests described in the previous testimony and we didn't think it necessary to encumber the record. If you like, however, I have the data on these tests and can produce it.

X-Q. 56. Now you said that you had the analysis of the water?

A. Yes, sir, I have it,—I haven't got it here, but I can get it. These water samples were taken right straight ahead and are on the records of the Utah Copper Company during the time this work represents. I will send for them if you would like them.

X-Q. 57. You haven't a specimen of the water, of course. You didn't take a specimen that you can give us?

A. No, sir.

X-Q. 58. And all of the assays that are given here are the assays as they were given to you; you didn't make any of them yourself?

A. Oh, no, no.

X-Q. 59. In fact, there was not a quantitative determination on these exhibits 212 and 213 that you made yourself?

A. Why, no.

THE COURT: Now, have you the stipulation?

MR. SCOTT: I will read the stipulation which was entered into.

(Whereupon counsel read the stipulation previously entered into.)

MR. GARRISON: I drew that stipulation, and it seems to me I am entitled to state what I meant by it.

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I meant by the first part to limit the testimony entirely, as its language does, to testimony regarding operations at the Butte & Superior. I intended the latter to be confined, as its language seeks to, and I believe does confine it, to regular operations, such as those that have been admitted here and testified to by Mr. Engleman and other witnesses as mill superintendents, to which testimony I first made the objection that they had not their original reports with them. And this was intended to obviate the necessity of their bringing the original slips of paper upon which these reports were made. The language is: "Provided that either party may produce witnesses as to regular operations." Now, this, I consider, was not a regular operation. It was something carried on by this gentleman under his direction after several days of preparation and was in every sense of the word a test, and a test carried on out of court without any opportunity for us to be advised of what was about to be done and without any opportunity to take samples or to inspect or be present when the oil was going in or when the acids were going in, all of which things are matters of primary importance. If this gentleman was advised by some one standing at the oil spigot that they were putting in twenty pounds, he has to rely upon that, that is all he knows about it. If that person should turn the spigot off for a fraction of a minute, the operation is entirely different from what he thinks it is. This witness can, with entire honesty, testify to different things—

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THE COURT: I understand your point. Of course, you have your stipulation here. That represents it.

MR. SCOTT: Counsel's remarks that he intended this to extend only to regular operations and not, to special or test operations, is not in accord with the acceptance and interpretation that has been given to this stipulation. These reports which have been introduced by these other witnesses without objection, after this stipulation from counsel, include test operations, operations to find out what will happen under this condition and under that condition, when this ingredient of the oil is omitted, and that when that ingredient of the oil is omitted. These things already received under this stipulation without objection from counsel include operations with extraordinary amounts of oil; and that is the only respect with the regard to which the present witness is going to testify that these operations differed from the ordinary operations, in exactly the respect that the evidence already introduced differs. What this stipulation means, it seems to me, is to be ascertained by how it has been accepted in this court, and how counsel have accepted it, not by what they say now, after both parties have acted upon the stipulation for two weeks.

MR. GARRISON: With respect to that, what has happened has been that when any one of these various allied companies have chosen to operate their mill for a series of days in a particular way, that becomes the regular operation of that mill for those days or weeks

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that they were so doing. It is an entirely different thing from a little experiment carried on by this witness under the circumstances here detailed.

MR. SCOTT: There is one of these reports, your honor, which is a report entitled "Abnormal operations" and for the purpose of determining abnormal profits as distinguished from normal profits. Confessedly they are not, upon their face, what counsel denotes as "regular operations".

MR. GARRISON: That seems to be building up a principle of law upon the leniency of the parties upon the other side, which cannot be done.

MR. SCOTT: You have waived that by stipulation.

The Court: Well, this stipulation, in its language, certainly contemplated regular operations and the result commonly understood as such, when regular records are kept as permanent files of the company. If they have departed from that somewhat, ~~you have departed from that somewhat~~, you have the benefit of that so far as it has gone, but I do not think it binds them continually. Personally, speaking as a court, I am inclined to doubt whether there is very much value to testimony of this character, experiments made while the litigation is pending, and as counsel says by allied companies, whom we can guess are confronted by somewhat the same condition as the defendant here, the same situation. And then, again, you were conducting these experiments twelve years after the patent and after three or four or five years of its prac-

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tical working operation, when machinery and mechanical operations have been improved from day to day, when things have been made possible now, no doubt, that would not have been possible when this patent was granted and applied for. At the same time, the court has felt that such testimony might serve a limited purpose, as indicated in its various rulings, but at this time, this testimony in the court's judgment does not come within this stipulation, and in the face of this objection that it is hearsay, the court is bound to sustain it and will sustain it in reference to these last two experiments testified to by this witness. I think we are on the safe side.

MR. SCOTT: We will bring the assayers and everybody else to prove it.

MR. KREMER: I would like at this time to clarify the record by inquiring of counsel particularly if the stipulations in the Hyde record, the whole record being stipulated in, is not a stipulation in this case? It will guide us in our conduct, when it comes to the presenting of their case, because if we are not going to be ~~found~~—if they are not bound by the stipulation in the Hyde record, certainly we are not, and we of course will object—I am making this statement for the purpose of expediting matters, giving due notice so there will be no controversy when the question arises when their case is presented. If we are to be bound by the stipulations in the Hyde case, and we have thought we were bound by them, then it is unnecessary to present to this court, under that stipula-

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tion, the assayer and the gentlemen who made an analysis. We stipulated in this case that—correct me, Mr. Williams, if I misstate this, because I am stating it solely from memory—that assays should be received as presented on their verity unless specially challenged. Am I not correct in that? There isn't even that exception, Mr. Scott calls my attention to.

MR. WILLIAMS: We will have the stipulation. There is a stipulation in the Hyde case and I understand that stipulation binds us in this case. We will start with that. There were several stipulations in the Hyde case but that stipulation—

MR. KREMER: If that is going to bind us it must bind them.

THE COURT: Well, find your stipulation. That is what we are looking at right now.

MR. GARRISON: I have based none of my objections upon the assays.

MR. KREMER: The objection was it was all hearsay.

MR. GARRISON: I said nothing, sir, in any of my remarks about assays. This is the first time the matter of assays has been mentioned. I said it was hearsay as to the amount of oil that went in and as to various other matters that this gentleman testified to, and I omitted ^{everything} about assays. I am perfectly willing to admit assayers' reports without the necessity of bringing them here.

MR. KREMER: There is no essential difference between an assay for a mineral and an assay for oil; it is all assay.

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MR. GARRISON: I have not said a word about objecting to anything on the ground of assay. I am talking about the amount of oil that goes in to the mixture, which is not subject to assay at all. It is subject to standing at the spigot and seeing it go in. I myself stood at one of these mills and saw the spigot turned off and on. Whether it is turned on or off depends on a physical fact which can only be testified to by witnesses who were present and saw it. An expert is no more competent to testify what was happening on a floor above him than I am and I am not an expert.

MR. KREMER: That is very true as far as it goes, but the only thing we are concerned in is the amount of oil that went in, and watching it go in is not the only way to determine that fact. An assay will determine its presence just as well as could be told at a spigot. We are certainly not called upon to discuss such an elementary proposition as that. Therefore, as this stipulation covers assays, it must cover all assays or it will cover none.

MR. SCOTT: Here is one stipulation appearing upon page 70, by Mr. Williams: "It is noted that the tests above described by the witness, not having been made in the presence of opposing parties, the observations and conclusions of the witness are objected to as not the best evidence unless an opportunity is afforded to complainants to repeat these experiments by supplying the complainants with sufficient quantities of the ores used in the condition in which

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they were used in these experiments, and also, if necessary, of the other reagents. With this reservation, no objection is made to the assay figures upon the ground that the man who made the assays is not produced as a witness." Further that is put in in a more formal shape.

MR. KREMER: We had a stipulation made preceding Dr. Chandler's testimony.

MR. WILLIAMS: I think what Mr. Scott has read was the first appearance of a stipulation in there. The general understanding was that if the assayer who was known and whose work would be deemed acceptable to both parties did the assaying why he would not be called upon to testify. There may have been something in Dr. Chandler's testimony by reason of the fact that some one assisted him in the assay.

THE COURT: The court has ruled. You may proceed.

MR. KREMER: Exception.

THE COURT: It will be noted.

MR. KREMER: Your honor, I do not know—for the purpose of information, your honor has ruled this entire testimony out, do I understand that?

THE COURT: These two tests that the witness has testified with respect to.

MR. KREMER: Will your honor permit us, so as to furnish a full statement of the record there—I don't know whether it would be necessary to submit a further offer to prove than that which appears in the record.

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THE COURT: If you desire.

MR. KREMER: If so we will ask leave to submit it.

MR. WILLIAMS: Now, I will cross examine the witness on the subject of curves.

X-Q. 60. On exhibit No. 202, Utah Copper Company, Magna plant, No. 1, I find along the bottom of the chart the numbers are 10.0, 12.5, 15.0 and so up to 55, which is the last number and apparently 60, as the value of the last vertical line, and this is entitled "pounds of new oil per ton of original feed." Now, first, please tell me what is the table from which this chart was made?

A. That was made from this Utah Copper Company, Magna plant, Metallurgical Department, vaner concentrate flotation plant, September, 1914, to December 24, 1916, inclusive, and on looking at this exhibit 195 I see that the pounds of oil per ton do not correspond at all.

X-Q. 61. Is that in error?

A. I noticed that the draftsman apparently in copying moved the decimal point one point to the right. If you will move the decimal point one point to the left it will give you 1.0, 1.25, 1.50, 1.75, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 and 5.5, and now the abscissae are correct. That changes of course in no way the relations expressed that the quantity of oil required increases as the amount of water in the feed increases.

X-Q. 62. Now, let us take curve No. 2, Utah

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Copper Company, Magna plant, Exhibit No. 207. As I understand it, or as I read the curve, when the feed contains 24.2% of sulphides in the feed, no new oil is required. Does the curve show that?

A. That most certainly would be a proper reading of this curve as an average.

X-Q. 63. That is to say you could operate without oil under those conditions?

A. No, I did not say that; I said that was a proper reading of that curve.

X-Q. 64. Then, that being a proper reading of the curve, the curve shows that as average, you can work without oil, is that correct?

A. The curve shows that, as an average, the amount of new oil per ton of original feed increases as the percentage of sulphide in the feed increases. Just as you can not predict from a curve of average life, that you are going to live to the age of average life.

X-Q. 65. I appreciate that fact.

A. The same thing here.

X-Q. 66. The same way in summer; if the mean average temperature of the month is 60, and a frost comes along and kills all the crop, you could not have predicted that frost from the mean average temperature?

A. Certainly not, but you can predict what the mean average temperature for the month is going to be, and in the case of life insurance you can pre-

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dict with sufficient accuracy to invest large sums of money on your prediction.

X-Q. 67. But your sums of money would not be invested unless you had so many of the variances that the average would be a reasonable basis for your prediction?

A. Of course not. No curves are useful unless that is the case.

X-Q. 68. So that all that you have determined is, as far as these tables show, that there is, in all the variances for a certain day, a sort of average of these variances along the line that you have indicated?

A. Why, certainly; that is all you can expect from mill operations. These particular variations are much more impressive from the fact that, notwithstanding all the unavoidable variances in mill operations, due to the ignorance of operators and so forth and so on, that this big general trend shows up through the record; it is extremely impressive. If we should show these things with laboratory machines, where we could personally say that we are going to vary these two things only so much, and hold everything else absolutely constant, that of course would be confirmatory, but it would not be so impressive as this, where, notwithstanding all these variances which are without control, this great general trend shows throughout.

X-Q. 69. Now, taking this average as a basis, I have followed your curve down to zero, and we reach the conclusion, I think, that we should not continue to represent the variations beyond zero.

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A. Of course it is a rule of all empirical calculations, that you should not carry them beyond the range of the data on which they are based. Nobody carries them beyond the range of the experiments from which he develops the curve; that is well recognized in all engineering.

X-Q. 70. That is to say, these curves represent only the average of these experiments?

~~X-Q. 70. That is to say, these curves represent only the average of these experiments?~~

A. Exactly so. We can ^{not} carry any empirical law based on experimental data beyond the range of the experiment upon which it is based, or the results upon which it is based; but throughout those results, throughout the range of those data, this curve represents the law.

X-Q. 71. And it seems to enforce the conclusion, does it not, that if, under similar conditions except the amount of oil, you change this average of about four and a half pounds of oil to twenty and a half pounds of oil, you are wasting oil, does it not?

A. Why, I think so, yes. I think we could most certainly have operated this—However, I think I had better correct that. If you can sufficiently increase your recovery to pay for the oil, then you are not wasting it. The matter becomes there one, however, of commercial operation and other factors enter. If

P. 3584, L. 28, insert " rather than one of scientific
technical operation " after " operation,"

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it is not wasted. If the reverse is the case, then it is wasted.

X-Q. 72. And if, by increasing the amount of oil you reduce the grade of your concentrates and diminish your recoveries, you would have to say that you are wasting oil?

A. If you decrease the net return to the company, you are most certainly wasting oil.

X-Q. 73. You mentioned a formula of Steinmetz for passing a curve through a set of empirical data. Can you give me a reference to the Steinmetz publication which described that?

A. No, sir, I can not.

X-Q. 74. Or any idea where it is to be found?

A. Why, I don't even know that. The thing goes so commonly by the name of the Steinmetz method of putting a curve through experimental points, that I have never taken occasion to look it up. I learned it when I was in college myself, and it has been called Steinmetz method, as I recollect, ever since. I can furnish you a reference, if you desire, by writing back to New Haven to men who are dealing more particularly with the actual teachings of mathematics, and get it that way.

MR. WILLIAMS: That is all, at present.

WITNESS EXCUSED.

Frank G. Janney.

FRANK G. JANNEY, recalled for further

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. Mr. Janney, did you have any communication with representatives of the plaintiff when they were in Salt Lake City and Garfield about a week ago?

A. I did.

Q. 2. And what was the nature of that communication and whom was it with?

A. I called Dr. Fulton by phone at the Utah hotel, and told him that we were conducting some experiments at the Arthur plant that I thought would be very interesting to him, and I asked him if he would like to come out and witness them. He said that he would discuss it with Mr. Chapman and let me know later. About 30 minutes later he called me on the phone and said it would be necessary for them to leave on the afternoon train for Butte, and that they would be unable to come out.

Q. 3. What day was this, Mr. Janney?

A. It was Sunday, the 22nd of April.

Q. 4. And about what time of day?

MR. WILLIAMS: If your honor please, it does not seem to me that this testimony is relevant to any matters that are of record. Here is the fact: it is true, Professor Fulton and Mr. Chapman, who are not of counsel, happened to be in Salt Lake City, and Mr. Janney telephoned to them and said "I would like

Frank G. Janney.

to have you come out—" and it was late in the evening apparently.

Q. 5. MR. WILLIAMS: It was in the evening, was it not, that you telephoned?

A. It was in the morning.

Q. 6. What morning?

A. Sunday morning about eleven o'clock.

MR. GARRISON: The experiment had then taken place.

MR. WILLIAMS: The work of inspecting the plant had been finished. Counsel were not present, and they were under no direction from counsel, and counsel did not know of that fact until now in court, and the whole thing is now irrelevant and immaterial and we move to strike out the answer.

MR. KREMER: I asked counsel the direct question if Mr. Fulton was their representative. Previous to that question being propounded the objection was interposed that their representatives, being then in Salt Lake City, were not advised of these experiments or given an opportunity to witness them, and I asked if Professor Fulton was their representative and he said he was.

MR. WILLIAMS: One of them.

MR. KREMER: One of them.

THE COURT: What could one man learn from such an experiment if he were there? He could see only one part of it at a time. There would be many other parts and factors involved, of which he could not keep any check in a mill operation of that sort.

Edward W. Engleman.

MR. KREMER: One man would be the man who would supervise the operation, and one man could supervise the observation.

MR. GARRISON: These experiments took place on Saturday, your honor.

THE COURT: The motion to strike will be granted.

Defendant excepted.

WITNESS EXCUSED.

MR. KREMER: Mr. Williams asked Mr. Engleman to have a number of reports and data prepared for him. Mr. Engleman now has some data to supply to Mr. Williams, but before doing so Mr. Engleman, I believe, desires to correct something in his testimony.

MR. WILLIAMS: His testimony of yesterday?

MR. KREMER: I don't know; he just mentioned it to me when he said he had these papers for you.

EDWARD W. ENGLEMAN, recalled for further

DIRECT EXAMINATION,
BY MR. SCOTT:

Q. 1. MR. WILLIAMS: I will ask the witness what page was the correction?

A. Page 1192—Well, 1191, really. Question No 138 we will have to start with.

Q. 2. BY MR. WILLIAMS: Proceedings of April 28th?

Edward W. Engleman.

A. April 28th.

Q. 3. You may make any correction that you have to make.

A. We will have to start with question No. 137 in order to get the complete understanding: "Q. Now, we will take the record for February 11th, 1917. A. Treated 463 tons heading, 456 tons tailings, 7 tons concentrates; 85.68 lbs. coal tar, 18.50 lbs. per ton of material treated. Q. 138. Now the assay. A. .680% copper in headings; .453 copper in tailings; 14.46 copper in concentrates; 50.20% insoluble; 7.20% iron." Now—

Q. 4. Now, do you go further?

A. Yes, sir.

Q. 5. I will read it: "Q. 139. Before I leave this particular plant what did you do with the material—What did you do with the kind and grade of material that you treat in this plant, before you installed it?

A. This material was treated on our big permanent installation. Q. 140. What kind of concentration?

A. Flotation concentration. Q. 141. No, before you had flotation. A. This material was going to waste.

Q. 142. Now, in other plant for retreating vanner concentrate products, is that right? A. Yes"—Is that all you want?

A. Yes; that is the part I wanted to correct. We did not send this product to waste. It was treated by the smelter.

Q. 6. What you have given as vanner concentrates?

A. The vanner tailings went to waste, but the vanner concentrates did not go to waste before flotation.

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Q. 7. The vanner concentrates went to the smelter and the vanner tailings went to waste, is that right?

A. Yes, sir.

Q. 8. MR. KREMER: Is there anything else?

A. Why, I have some data here that was missing on the sheet presented.

Q. 9. I mean that you wanted to correct?

A. No.

MR. KREMER: The paper is a tabulation of some matters requested by Mr. Williams on cross examination, entitled "Ray Consolidated Copper Company, data compiled from Monthly State—" etc. We offer it in evidence.

Table admitted in evidence without objection marked DEFENDANT'S EXHIBIT 214.

Whereupon further hearing was adjourned until 2 p. m.

2 o'clock p. m. May 2, 1917.

MR. SCOTT: In order to simplify matters and to avoid unnecessary taking up of time, I would like to get clear myself—Possibly the rest are clear but I am not—just exactly the grounds of the court's ruling in excluding the testimony of Professor Taggart. As I understood, the plaintiff's objection was on the ground that the experiment was ex-parte; whereupon we of-

ferred to repeat the test and that was accepted came an objection, as I understood it, on the that the evidence was hearsay, the witness not personal knowledge of everything that had taken and when that objection was raised there was discussion upon the subject of assays, and as understood, counsel for the plaintiff stated that I not insist upon proofs of assays. Now, as I have been able to sift it out, that seems to be grounds that are relied upon to the weighing headings and the tonnage of headings and so just what is left I don't know.

THE COURT'S ruling was on the theory developed that he had not sufficient personal edge of all the factors that were connected with operation to speak of them other than by that was all I had in mind at the time.

MR. SCOTT: That is the way I understood court's ruling, but as I further understood I think I am quite correct, counsel signified that had no objection to accepting assays.

THE COURT: I think you have a stipulation that effect; wasn't one read?

MR. SCOTT: The court ruled that there were not regular operations but rather experimental operations of the mill.

THE COURT: When that matter came up the ruling was made, this testimony of Professor Gart was held not to be within such stipulations some one or both of them mentioned stipulations.

Edward W. Engleman.

Q. 7. The vanner concentrates went to the smelter and the vanner tailings went to waste, is that right?

A. Yes, sir.

Q. 8. MR. KREMER: Is there anything else?

A. Why, I have some data here that was missing on the sheet presented.

Q. 9. I mean that you wanted to correct?

A. No.

MR. KREMER: The paper is a tabulation of some matters requested by Mr. Williams on cross examination, entitled "Ray Consolidated Copper Company, data compiled from Monthly State—" etc. We offer it in evidence.

Table admitted in evidence without objection
marked DEFENDANT'S EXHIBIT 214.

Whereupon further hearing was adjourned until 2 p. m.

2 o'clock p. m. May 2, 1917.

MR. SCOTT: In order to simplify matters and to avoid unnecessary taking up of time, I would like to get clear myself—Possibly the rest are clear but I am not—just exactly the grounds of the court's ruling in excluding the testimony of Professor Taggart. As I understood, the plaintiff's objection was on the ground that the experiment was ex-parte; whereupon we of-

ferred to repeat the test and that was accepted. Then came an objection, as I understood it, on the ground that the evidence was hearsay, the witness not having personal knowledge of everything that had taken place, and when that objection was raised there was a discussion upon the subject of assays, and as I understood, counsel for the plaintiff stated that they did not insist upon proofs of assays. Now, as far as I have been able to sift it out, that seems to reduce the grounds that are relied upon to the weighing of the headings and the tonnage of headings and so on, and just what is left I don't know.

THE COURT'S ruling was on the theory that it developed that he had not sufficient personal knowledge of all the factors that were connected with this operation to speak of them other than by hearsay; that was all I had in mind at the time. *The*

MR. SCOTT: That is the way I understood the court's ruling, but as I further understood, and I think I am quite correct, counsel signified that they had no objection to accepting assays.

THE COURT: I think you have a stipulation to that effect; wasn't one read?

MR. SCOTT: The court ruled that those were not regular operations but rather experimental operations of the mill.

THE COURT: When that matter came up, after the ruling was made, this testimony of Professor Taggart was held not to be within such stipulation. Then some one or both of them mentioned stipulations in

the Hyde case, which are a part of this trial. Now, how far those stipulations go, I am not advised.

MR. SCOTT: I wanted to be clear about whether this matter of the assays was waived, or whether we would be obliged to support this testimony by the individual assayers who performed the operation; and if counsel will state that, it will clear things up and simplify the further proceedings.

THE COURT: If you are not in accord about it—about what the stipulations cover, the court will have to rule on it.

MR. GARRISON: I don't know what the stipulations contain, myself.

MR. SCOTT: We will proceed upon the assumption that all assays must be proved hereafter, and all other details, and we will so be governed.

MR. WILLIAMS: There is no ground for that assumption.

MR. GARRISON: I was waiting for Mr. Scott and Mr. Kremer to finish. What I said was that I do not base any objection or contention upon the verity of the assays; that my objection did not in any way attack the verity of the assay. I did not waive anything. I am perfectly willing to consider the matter with counsel on the other side and see what the stipulation should be to cover that matter, but I waive nothing. I simply said that my objection did not refer to assays, and the first time the word assay was mentioned, was by Mr. Kremer. That is the fact

THE COURT: Of course the court is ruling on matters as they are properly presented, but off the record, I would take it that the stipulation in the Hyde case goes to assays as they were presented, that they could present the result of an assay as from the assayer, but not from the oral statement of someone else; that is, that both parties would be inclined to accept an assayer's certificate, if he was a disinterested party. I don't know how far these stipulations go, because I have not read them.

MR. SCOTT: I think they are too narrow to cover the present case, and that is why I made this inquiry; but my effort having failed, we will proceed on the assumption of presenting rigid proof.

MR. GARRISON: This is informal, of course, and I don't know exactly what is pending, but I assume that what is pending is your honor's ruling. I want it thoroughly understood that my objection to the test made by Professor Taggart on the 21st of April is much broader than whether or not his basic information was hearsay. I do not wish any misunderstanding in respect to that, and I do not want counsel to say that they are surprised when I urge much broader and deeper and more radical objections than the one that is based upon hearsay. I endeavored to state that it seemed to me that those experiments do not come within any recognized principle of evidence; they are self-serving declarations made up by the defendant; that they are not performed under any conditions which enable us to verify their accuracy or their force; that the only proof which is relevant here is with re-

spect to the prior art, and that this does not in any way, and can not in any way be said to represent the prior art or any part of it, operations carried on on the 21st day of April, 1917, in machines which were not invented until years after the patent in suit—such things can not by the wildest stretch of counsel's imagination be brought within any part of the prior art, and I shall urge all those objections, in addition to the objections which applied to the specific facts stated as a basis for their testimony.

MR. SCOTT: I don't want to consume unnecessary time, but it is a question of the process and of the verity of the statements in the patent in suit. We claim that we have shown that the patent in suit is an absolute misstatement of the facts, which statement of facts we are entitled to attack in 1915 or 1906 or any time while the patent is in existence.

THE COURT: I have heretofore ruled that I thought experiments, present day experiments, would be proper and admissible for limited purpose. They must have some relation to the prior art, to the condition of things as they were at the time this patent was applied for. How much weight they will be entitled to, or how little will depend upon the conditions under which those experiments have been made. Of course some of them may be such a wide departure from things as they were understood to have been at the time of the application; that they would be entitled to no consideration, and others might approximately more closely and be entitled to more consideration, and some might duplicate—some might assume

to duplicate conditions as they were then at the time that the patent was applied for. But certainly it seems to me that with the accumulation of learning, both from study and from new discoveries, or from mechanical operation, new machinery multiplying operations—it seems to me that if your experiments are to include things of that nature, they would not illustrate very brilliantly the prior art. It is a question of degree, of course.

Take this experiment of the Everson—the Fryer Hill publication. There is a machine which is supposed to give us the Everson operation as described in that publication. It seems to me now, as I said then—of course I am open to argument and open to explanation by counsel—but it would seem to me that one factor entered into that which I do not find in the Everson patent, viz. the agitation, which at least this court originally maintained was a proper part of the invention in suit. I could not find in the Everson patent that agitation should be resorted to; it does say thoroughly mixed, but you must read the context of the patent, read the full expression, to understand what she was aiming to do and what she meant by that expression. About your other experiments the same might be said; it is all a question of degree. Some of these experiments may go over the line of admissibility, that is likely to happen ⁱⁿ ~~to~~ any case.

MR. GARRISON: All I was trying to do was to prevent counsel from saying, as the result of this colloquy, that if they brought certain evidence as to the

assays, that the defendants would have met the objection as they understood it, and they did not meet it as I understood it, and I did not want them to be able to claim surprise.

THE COURT: Oh, yes. I understand from the very beginning, as far as these experiments are concerned, that there is standing objection which was interposed at some time at the very beginning, and which both parties will not lose sight of, when the court makes up its decision.

MR. KREMER: So there will be no further misunderstanding, we will apply to the strict letter of proof in this instance, and insofar as the stipulations, if any, in the Hyde case are concerned, we will place a strict construction upon those stipulations, so that counsel will now be advised; and we will demand a strict order of proof, such as is demanded of us, in the presentation of their case, so that they won't say they are surprised.

MR. WILLIAMS: That is to say, the defendant having about finished its case, and the complainant being about to commence its rebuttal testimony, defendant now announces that every stipulation of record is to receive a strict construction, notwithstanding the fact that a great mass of evidence has been let in without that. I do not accept that.

THE COURT: No, no; the court understands, and whenever you have any evidence to offer you can bring it up before the court in connection with these stipulations, and the court will read the stipulations. I

have been very liberal with the plaintiff, but these last experiments are clearly outside the stipulation.

MR. KREMER: What we desire to avoid, if your honor please—I don't want the court to misunderstand—any stipulation we have made we will abide by, but that we want to make an offer of proof and we can not do that without the presence of the witnesses.

I can't make an offer of proof by somebody who is not on the stand, and we are going to have the witnesses here present upon the stand in order that we might make a legal offer. Well, I am not addressing myself to the ruling of the court; the court has ruled and I don't care to comment or discuss that at all; that is past; but as a result of that objection, this condition is made necessary by reason of that objection, demanding the strict letter of proof. There is nothing that we can do under those conditions, except to meet the demand, as your honor will readily understand.

MR. GARRISON: I am not demanding anything.

MR. KREMER: You demand evidence as to assays which is the same as demanding the evidence of the men who held the samples.

MR. WILLIAMS: We draw a distinction between assays of regular operations of the mill and experiments.

MR. KREMER: I think we understand each other.

MR. SCOTT: I want to know if this is an objection because this is an experimental operation, as distinguished from the regular mill operation. I don't

think the court based its ruling on any such objection as that. I think the court based its ruling on a question of evidence, and not upon this vague objection that this was an operation out of the usual run of the mill operations; if that is the objection that counsel made or that the ruling was upon, I think they should say so here and now, so that the court should rule upon that objection, which I do not conceive the court has ruled upon at all, except in certain instances where similar objections were made—not identical—the court has overruled them.

THE COURT: Have you heretofore offered experiments like these?

MR. SCOTT: Obviously we have had experiments by Mr. Conrads as I remember at the Magna plant, Mr. Thomas Janney at the Arthur plant, in which they used amounts of oil far out of the ordinary, up to 100 pounds per ton and there has been a general objection, it seems to me, on all of this testimony on the ground that we were estopped from trying the case at all.

THE COURT: Under stipulation as to regular operations, I think.

MR. SCOTT: But these were not regular operations in the sense that counsel has stated the matter this morning, that this is not a regular operation, having this large amount of oil as the court so held.

THE COURT: That is what I say, this one, but the others perhaps went in under this latter.

MR. SCOTT: What I want to get is whether the objection he now is making is upon the ground that this

is an experimental and not a regular operation or whether that operation is limited to the proof.

THE COURT: The court has ruled on the proposition, simply it is one of hearsay. I have not ruled that these experiments were not admissible, but I have pointed out to you all along throughout the record that they may be entitled to very little weight. I cannot sit here and wait while you try and experiment below Salt Lake, and then for them to go down and check that up and see if they can verify it or anything of that sort. I do not think they ought to be put to that trouble, or that the court ought to sit here and wait for them. You have the utmost freedom with all of your experiments in court, as far as that goes.

MR. SCOTT: The offer was simply to check up the experiment. Counsel has ruled upon this question, as it has very properly upon the question of evidence produced, that the proof must be more complete. Counsel still say that that is not their objection, but they do^{not} say what their objection is, and give the court an opportunity to rule on it, or give us an opportunity to meet it.

THE COURT: They too have objected that these experiments under present day conditions are inadmissible, and I think the court has rather persistently ruled against them. I believe if there are other experiments taken away from Butte in evidence—I don't believe they were specially objected to upon that ground. Of course they may have been.

MR. SCOTT: I think with this understanding that we will proceed. I don't recollect whether Mr. Engleman completed everything you wanted of him.

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MR. WILLIAMS: Mr. Engleman put in evidence a statement which filled certain gaps in his statement and the only question I would present to him appears on the face of it. You may go on with the next witness.

DR. SAMUEL P. SADTLER, Recalled, testified as follows:

DIRECT EXAMINATION

BY MR. SCOTT:

Q. 164. I think when you were on the stand before you referred to a certain work describing what was called the cataract machine, and counsel for the plaintiff asked that you supply an additional page of that work. Is this the additional page which was called for?

A. I have here a number of copies of the page just preceding the page containing the illustration, and that was desired because the description of the experiment, or rather the description of the form of apparatus began on that preceding page so that with the page already offered and this page we have the complete story of this apparatus.

Q. 165. I wish you would state the title of the book from which this exhibit which was admitted as exhibit 50 was taken. Just state the name of it and when and where published and the title?

A. The book is entitled "The drying oils, their properties, compositions and changes, a hand book for

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lacquer, varnish and color manufacturers, and so forth, by Louis Edgar Andes." Published in Germany, Braunschweig, in 1882.

Q. 166. In your previous testimony, doctor, when you translated the pertinent part of this extra page—the complete translation with the part that is on this page and the other part ^{added} ~~on the other page~~ with the illustration, was trans~~mitted~~ and entered into the record.

MR. SCOTT: Now, if counsel can consent we will have this added to the exhibit without the formality of offering and further complicating the number of exhibits.

MR. WILLIAMS: This is consented to.

Q. 167. MR. SCOTT: I think when you were on the stand before you referred to several mechanisms described and illustrated in Ure's Dictionary of Arts, manufactures and mines, published in 1860?

A. Yes, sir.

Q. 168. I hand you photographic prints and ask you if those are photographs of the pages of that work that you refer to?

A. I have had photographed the title page and pages 331, 332, 335, 356, and 357, containing illustrations and descriptions of several forms of spitzkastens, and one form of agitating apparatus, involving aeration, when rapidly used, and these are photographs of these pages which were referred to in my previous testimony.

MR. SCOTT: I offer the photographic copies from

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Ure's Dictionary, referred to by the witness, and ask counsel if it will be stipulated that these are copies of the pages referred to?

MR. WILLIAMS: It is so stipulated, subject to possible correction on further examination, but I guess not any.

Pages admitted in evidence and marked
DEFENDANT'S EXHIBIT 215.

Q. 169. MR. SCOTT: Were you present in court, Dr. Sadtler, when Mr. Dosenbach performed two experiments illustrative of the Everson patent, one in the Fryer Hill machine and one in the cataract machine?

A. I was.

Q. 170. I am assuming that you will be unable to remember all of the facts and details and I will refer you to the description of the details as given by him in the typewritten transcript and ask you to compare what he did with what is described in the Everson patent. (Page 1212 of the statement of facts.)

A. This was an ore which was crushed to 40 mesh, as stated here and a portion of this ore having been taken and another portion given to representatives of the plaintiff. 51 gms. of oil were taken, these 51 gms. of oil, taking into account the specific gravity of the oil, figures out exactly 17 per cent of oil relative to the ore, which was the proportion cited by Everson in her description of the operation using paraffin oil. In that particular case an oil of a certain gravity was taken and a calculation readily allowed the ascertain-

P. 3603, L. 14, insert "a sample of the concentrate was obtained—that having been done." after "done,"

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ing of the relative weight of that oil per unit of ore. Therefore, it was 17 per cent. 1250 c.c. of water having a temperature of 42° C. were used. 2.4 c.c. of sulphuric acid added to 50 c.c. of hot water were added after the machine was started. The rotation was between 1400 and 1500 revolutions per minute, as experimentally tested. After rotating the revolving blades there was obtained a mineral froth of the copper sulphide mineral and air bubbles, and this amounted to something over an inch in thickness, from an inch to an inch and a quarter. The difference in appearance between this froth, in color, and the tailings was quite noticeable. That having been done, the Fryer Hill publication was followed still farther in that the semicircular doors which previously had been hanging down during the time of the rotation, acting thereby as baffles during the rotation and assisting in the entraining of air, these semicircular doors were raised so that they came up just under the layer of the floating froth. I examined them at the time and noticed the position of the doors and they were in position after being raised and the froth collected upon them. Then by lowering the jar with its contents, that is the liquid under the froth, it was possible to hang or to leave these doors supporting the froth and separated in that way from the other portions of the liquid. In the Fryer Hill publication we have the description of these parts of the drawing and it states that the water will drain through the fine openings in these semi-circular doors leaving the floating mineral

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upon them. Samples were taken of that concentrate by washing the material off of these supporting doors, after having removed the other portion of the liquid below. I consider that this was a carrying out of the Everson process in principle. I consider it was a very careful following of the Fryer Hill description also in which a form of apparatus was described which had been utilized for the illustration of the Everson process.

Q. 171. Referring to the Everson patent and particularly to the procedure as defined in the paragraph beginning at line 93, page 2 of the patent, page 608 of the Hyde record, I would ask you what, if any, directions you have for such agitation of the mass of pulp and oil as took place in the Fryer Hill machine?

A. "In the use of petroleum, or a liquid constituent thereof, like paraffin oil, the condition of the concentrated mass is more liquid than when a vegetable or an animal oil or a fatty constituent thereof is used, and a somewhat different means or method should be employed for removing the sand. In practice, the concentrate, after thorough agitation of the mass and detachment of the sand, will in this case be perfectly removed by means of a constant overflow of water, from a washing out vessel, by which overflow the concentrate will be floated off." We have there of course the thorough agitation as the first step, the detachment of the sand is the second step and the removal of the concentrate as the third step. This is all illustrated in this procedure using the Fryer Hill form of apparatus.

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Q. 172. Now, doctor, will you turn for a minute to the patent in suit, No. 835,120, and tell us what language you find there regarding the character and degree of agitation.

A. In the patent in suit we have the statement with regard to agitation as follows, on page 1, beginning with line 82: "The mixture is warmed say to 30° or 40° C., and is briskly agitated in a cone mixer or the like as in the process previously cited, for about two and a half to ten minutes, until the oleic acid has been brought into efficient contact with all the mineral particles in the pulp." Then we have a description of what results from that agitation.

Q. 173. What was that process previously cited that is referred to in the passage you have just quoted?

A. I assume that it refers to the Cattermole processes which were cited in the earlier parts of this same patent.

Q. 174. Can you state whether any especially violent agitation was a characteristic of the Cattermole process.

A. It was.

Q. 175. Now; did you see the second experiment performed by Mr. Dosenbach as representing the procedure of the Everson patent in which experiment he used what was called the cataract machine described in the German book by Andes?

A. Yes, I also witnessed that.

Q. 176. I will refer you to the transcript for the details.

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A. Found on page 1217 of the transcript. 300 gms. of Utah Copper retreatment classifier overflow, containing approximately 7.9 per cent copper, 5.36 per cent iron and 77 per cent insoluble, was taken as the ore. To this ore was added 51 gms. of petroleum distillate. This was also calculated to make 17 per cent of oil reckoned on the ore, and it was thereafter mixed until a homogeneous mass was formed. This mixture, following the Everson process, was made before the thinning out of the pulp with water. This oiled ore was placed into the cylinder of the machine and 1250 c.c. of water added at a temperature of 40° C. The machine was then started up and 2.4 c. c. sulphuric acid, and 50 c.c. of hot water was added, and the agitation continued for a period of two and one-half minutes. Upon stopping agitation a mineral froth formed above the semi-circular doors—that “above the doors” was not necessary there—being about one and one-eighth inches in thickness. After allowing the gangue material or tailings to settle to the bottom of the cylinder so that the solution was comparatively clear between the froth and the gangue—

MR. SCOTT: You are reading the wrong description.

A. I read the description that followed after that.

MR. SCOTT: The ingredients are the same but the apparatus was different. I will find it for you.

MR. WILLIAMS: What you have just read is the alleged Fryer Hill experiment.

A. The semi-circular doors identify that.

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MR. SCOTT: Page 1218 I think it begins.

A. That is just what I was reading, 1218. The description of the apparatus begins on page 1220 and continues on page 1221. The oil and the ore were thoroughly mixed as before. And the description of the apparatus in detail is on page 1223. In the experiment just completed, following out the Everson patent in the so-called ~~Catermole~~ ^{Cateract} machine—that is 1223—"I used 200 gms. of Utah copper retreatment classifier overflow containing about 6.18 per cent copper, 6.69 per cent iron, and 76.2 per cent insoluble. I added to this 200 gms. of ore, 34 gms. of Texas petroleum distillate and thoroughly mixed the two to form a homogeneous mass." That 34 gms. is again 17 per cent on the ore taken. "I thoroughly mixed the two to form a homogeneous mass." The mixture was made as in the other case before thinning out with water. "Having placed this oiled ore into the machine, I added 1250 c.c. of water at a temperature of 30° C. I next started the machine and directly after starting the agitator I added 50 c.c. of hot water containing 1.6 c.c. of concentrated sulphuric acid. The agitation was continued for two minutes and a half at about 1720 revolutions per minute. The result upon stopping the agitator was that a very highly mineralized froth appeared on the surface of the pulp." The sample was removed and furnished to the complainants for examination. I witnessed that operation and noticed the appearance of the froth at the time.

Q. 177. And what was the result of your observation of the froth and the experiment generally?

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A. It was a very dark, mineralized froth, and as stated was approximately one and one-quarter inches or more in height, being rather more than in the preceding experiment with the Fryer Hill apparatus.

Q. 178. With the exception of the difference in the apparatus, did you notice any other differences in the procedure and in the ingredients used between this cataract machine described and the one in the Fryer Hill machine?

A. There was no difference in the principle. There was a difference in the amount of ore that was used and a difference in the amount of oil used. The ratio was precisely 17 per cent oil to the amount of ore taken. It was the same ore in the two cases and the agitation had the same effect, in the cataract machine as it had in the other form of apparatus, in the entraining of air and the result of that in turn was the formation and—formation of an aerated froth which was highly mineralized, which it showed on coming to rest.

Q. 179. Are you familiar, doctor, with the Froment Italian and British patents?

A. I have read them carefully.

Q. 180. Will you explain the process set forth, especially with regard to the Froment Italian patent.

THE COURT: Any difference.

MR. SCOTT: Just slight difference which the doctor will refer to.

A. The Froment Italian patent I will first notice.

Q. 181. THE COURT: These are in the Hyde suit?

P. 3608, L. 17, insert "with the semi-circular doors, the agitation resulting " after " apparatus "

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MR. SCOTT: This is the Hyde case, yes.

THE COURT: Proceed.

A. The Froment Italian patent has as its title in the translation which I give it, "A Process for Enriching the Sulphide Ores of Copper, Lead, and Blend by gases combined with fatty bodies." This differs very slightly from the English translation which was submitted in the Miami record.

Q. 182. In the Hyde record?

A. In the Hyde record also previously. I think the translation I gave it is a little better because it does not say "Sulphide and copper ores" in the original French, but it says, "The Sulphide Ores of Copper" because the word "sulphures" there is used as an adjective and it is the sulphide ores of copper. Therefore, I prefer the translation as given: "A process for enriching the sulphide ores of copper, lead and blend by gases combined with fatty bodies." There is no word in this title, the original French of the Italian patent, or in the English translation which was given in the Hyde record, there is no word offered of its being a modification of any previously known oil process of ore concentration. That does not appear at all in the Italian patent. I will refer to that again. Now, we take up next in the Italian patent the phenomena. Mr. Froment says: "The following phenomena studied by the inventor have served as the basis of the patent, which forms the subject of this invention." These phenomena are four in number and as stated I would like to read them consecutively so that we can consider

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them together: "First, when the natural sulphides reduced to fine powder are moistened by a fatty substance they have a tendency to unite in spherules and to float upon the surface of the water.

"2. This tendency is simply retarded by the specific weight, and opposed by the gangue which imprisons the moistened sulphides in its pulverulent mass.

"3. If a gas of any kind is generated in the mass, the bubbles of this gas become covered with an envelope of sulphides and thus rise readily to the surface of the liquid where they form a kind of metallic magma.

"4. The formation of these metallic spherules is singularly active if the gas is in a nascent state."

Now, these are the four phenomena stated together as a basis of the Froment invention. This represented his invention which he considered to have been original. It seems to me that to understand Froment's discovery these phenomena must be considered as connected and not analyzed singly, as only thus can we arrive at an understanding of his meaning—a proper understanding of his meaning. For instance, the reference to "spherules" in the first paragraph cannot be understood until after we have read the third paragraph when this very expressive term becomes understood. In previous discussion of this matter it has been attempted at times to give two entirely different meanings to the word "spherules," contending that it meant one thing in one paragraph and another thing in another paragraph. I think I can show that is not a proper interpretation of Froment's meaning. The

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mere moistening of the fine powdered ore with a fatty substance could have no effect to produce spherules that would float on the surface of the water whether we add much or little fatty oil. We would get the pasty mass of Haynes or the first Everson example, and the addition of water to this while allowing for the washing out of the gangue would not cause the production of spherules that would float upon the surface of the water. If there was an occasional little appearance of oil in the water this would not be properly described as "spherules" in the meaning as given here. If, however, we read the statement of the third paragraph and remember what is said in the first paragraph about the spherules floating upon the water, the phenomena are readily intelligible. The generation of gas in a mixture of ore, oil and water under the conditions given, and immediately after in his example also will have the result described in the third paragraph, namely: "The bubbles of this gas become covered with an envelope of sulphides and thus rise readily to the surface of the liquid where they form a kind of metallic magma." We can now understand the fourth paragraph immediately following: "The formation of these metallic spherules is singularly active if the gas is in a nascent state." If, "spherules" were to be taken apart and considered as formed under the conditions mentioned simply as there in the first paragraph, we couldn't have any meaning to this fourth paragraph. The meaning of the fourth paragraph is only possible when we have the full connection with several

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phenomena, the mixing of the sulphide ore with the fatty substance, the generation of the gas in this mass and then the presence of water so that we shall have a liquid in which something can rise, and then we have stated that "the bubbles of gas, covered with an envelope of sulphides rise to the surface of the liquid," where they form a kind of metallic magma." Now, on the top of the next page in this Froment Italian patent we have still more light thrown upon this matter. We have this statement:

"Accordingly the rapidity of the formation of the spherules and their ascension is in direct ratio to the quantity of gas produced in a given time."

Q. 183. Just where is that, doctor?

A. I think it immediately follows, just before example 1.

MR. WILLIAMS: The latter part of page 910 of the Hyde record.

Just before example 1. There we have so clearly expressed the condition of the formation of the spherules to be dependent upon the generation of the gas and the greater or less rapidity with which they will rise are based upon that, that it is utterly ridiculous to talk about two kinds of spherules referred to by Froment. The spherules referred to by Froment are only a development after gas has been generated. Now, we come to the third paragraph, especially to this phenomenon again of the magma. What is it that is there stated to form a kind of metallic magma? The answer to that is: the bubbles of gas covered

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with an envelop of sulphides which rise to the surface of the liquid. These bubbles of sulphide-coated gas are obviously referred to in the fourth paragraph, where their formation when the gas is in the nascent state is spoken of, and they are called metallic spherules, from their round form as they show in the coherent froth or magma. This clear meaning is, however, confirmed in the illustrative example which is given immediately following. We have the statement: "The metallic spherules, pressed one against the other, will become grouped in a magma, clearly separated from the remainder of the liquid."

THE WITNESS: In illustrating the example we have there the statement "the metallic spherules pressed one against the other, will become grouped in a magma clearly separated from the remainder of the liquid." Now, we have the definition of magma in Froment's own language, "The metallic spherules, pressed one against the other," and we are very familiar with that appearance by looking at these mineral-coated froths, looking down at them from on top—"and the magma clearly separated from the remainder of the liquid." This is what Froment meant by a magma, clearly expressed in his own words and defined for us, no matter what other definitions have been found for the term in metallurgical usage or in smelting practice.

Of course it is entirely possible to find many illustrations of magma, and the word magma has been used in a great many connections and in a great many

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lines of practice, but we are tied up here by Froment's own explanation and description of what he means. "It is the predecessor of the fixed, coherent, armor-coated froth of the patent in suit." It looks like it, and is similarly constituted, and is produced by the same steps, namely the agitation of a sulphide—containing ore with oil and sufficient excess of water to entrain air, and thus cause the formation of air bubbles which, as Froment says in the third paragraph—I should say gas bubbles, because it must be made broader than air bubbles—"gives rise to the formation of gas bubbles" which Froment says become covered with an envelope of sulphides and rise rapidly to the surface of the liquid, where they form a kind of metallic magma. The result is the same froth whether we take it as a number of "metallic spherules pressed one against the other," using what he has called or considered as grouped, into "a magma clearly separated from the remainder of the liquid," or whether we talk about "coherent, armor-coated froth."

Now, these are my conclusions, reached after a very careful study of Froment's language, analyzing every word of it and trying at the same time to bring the several parts of his description together, and they also are based upon my observation of a great many highly coated froths which have been produced in numerous experiments here, and I would like particularly to call attention to this description of Froment, in connection with the pictures and photographs which have been put in evidence, particularly if we look only at the photo-

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graph in which the picture is taken looking downward. The appearance of the armor-coated froth is absolutely the appearance of the "metallic spherules pressed closely together and forming a magma," as described by Froment.

I would also like to say that this description of Froment's, of his mass of metallic spherules forming a magma, and the appearance of the metallic-coated froths as seen in the photograph, exactly illustrates the definition of the froth which was given in this testimony by Professor Bancroft. Professor Bancroft's definition of a froth—and it is of record—was as follows: "Froth is a closely packed mass of bubbles having a honey-comb or cellular structure, the walls of the cells being liquid films, and the individual cells containing air or other gases." That is broad enough to include air and other gases or mixtures. And then add to that definition of a froth the result which ensues when we have the froth generated in the presence of an oil, and the selective action whereby the mineral sulphides concentrate in the film inclosing the bubbles.

Then we pass from the froth, as a broad expression, to the special mineral-charged froth of the patent in suit, and of these other illustrations which we have considered. I have also in my previous testimony referred to the language of the two patents of 1910, taken out by Theodore Jesse Hoover and Minerals Separation Limited in one case, and by Edward H. Nutter and Minerals Separation in another case, in which they cite, the English patent No. 12778 of 1902,

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which is the English patent of Froment, and in which English patent these descriptions and these statements of the phenomena, and this description of the metallic spherules and of the magma, is exactly the same as it is in this Italian patent, translated. They refer to the result of the Froment patent as showing the process of carrying oiled particles to the surface, and they bracket this British Froment patent with the English patent corresponding to the United States patent No. 835120, as being descriptions of well-known flotation processes.

I had another reference here, but I can't find it.

I now pass to the features of the Froment process as shown in the example which immediately follows the statement of the four phenomena. We have, following that statement of the phenomena an example of an experiment in a test tube, and I will take that up.

First, the components of his mixture, he states here are ten grams of sulphide copper ore with its gangue, 1 gram of limestone, reduced to powder, and 30 drops of water, and a few drops of sulphuric acid, and a thin layer of ordinary oil. In this mixture as thus stated, the ten grams of powdered ore furnish us the sulphide particles and gangue which as a result of the process are to be separated. The one gram of limestone is to react with the sulphuric acid and thus to generate carbonic acid gas, which furnishes a part of the bubble by the gas, which is the basis for the rising spherules referred to in the last paragraph of the example. The 30 grams of water give us the floating

P. 3616, L. 8, insert " in the form of a froth or especially
as a gaseous froth," after " surface,"

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pulp, and is the liquid on the surface of which the metallic spherules that are grouped in a magma clearly separated from the remainder of the liquid are supposed to float, and the few drops of sulphuric acid liberate some carbonic acid gas. The few drops of sulphuric acid—we might take two or three—being insufficient to decompose the whole of the one gram of limestone contained.

In that connection, a calculation can be made as to how much of the limestone would be decomposed by the few drops of sulphuric acid. Dr. Chandler has stated in the Hyde record, volume 2, page 647, that 1 c.c. of sulphuric acid amounts to from 26 to 32 drops, and other experiments have been carried out and have given the statement that 40 drops constitute 1 c.c. Being very liberal with that, and taking the figure of Dr. Chandler, we can readily calculate how much that 2 drops of sulphuric acid will furnish, therefore, in weight; of course, knowing the weight of 1 c.c. of sulphuric acid—the sulphuric acid referred to is the strong sulphuric acid, and 1 c.c. of that weighs 1.84 grams, because that is the specific gravity of strong sulphuric acid, ~~and 1 c.c. of that weighs 1.84 grams, because that is the specific gravity of strong sulphuric acid.~~ Therefore, if we take 2 drops, we would have perhaps only 1/15 or 1/20 of that 1.84 grams, as the active sulphuric acid which is to decompose the limestone. Now, pursuing the calculation, 1 c.c. of sulphuric acid, weighing 1.84 grams, in decomposing limestone will produce .8 of a gram of carbon dioxide,

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which amounts to .4 of a litre. Those figures can be found in Dr. Liebmann's testimony—that is, the calculation may be found in Dr. Liebmann's testimony; I can not give you the page for the moment, but I will give it later. Dr. Liebmann has given us that calculation exactly, that 1 c.c. of sulphuric acid produces .8 of a gram of carbon dioxide, amounting to .4 of a litre. Now, 2 drops thereof, the $1/15$ or $1/20$, according as we regard the number of drops, to the cubic centimeter of sulphuric acid, would produce, therefore, about .04 of a gram of carbon dioxide, which would be .02 of a litre, or 20 c.c. of carbon dioxide, which would be produced—and I will be liberal with that and make it 30 c.c. of carbon dioxide which would be produced by using 2 drops of sulphuric acid, acting upon 1 gram of limestone present in this mixture of Froment. Therefore we get a partial decomposition, with a possibility, using the larger figure, of 30 c.c. of carbonic acid gas liberated in this test tube experiment, which is here described by Froment.

The remaining element of the mixture is the oil. The words used by Froment are, "or a thin layer of ordinary oil." This does not state the amount by weight or measure, and does not give a definite description of the kind or amount of oil, but we can make a guess at how much he meant and what was the character of the oil. First, what did Froment mean by an ordinary oil? Fortunately, he tells us in this same Italian patent which we are considering, in the claim in the Italian patent, according to his expression, "com-

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bined with an oily fat body, and not with with an oily body derived from bitumens, tar, naptha, etc." This is perfectly clear as a definition. He does not use petroleum or any derivative of it, or any residuum of petroleum, nor tar nor any residuum or residual of tar. What he did use was a so-called fatty oil, or it is sometimes called, to distinguish it from the essential oil or volatile oil, a fixed oil. However, Froment goes still further in making his meaning definite. In the original French used in the Italian patent he says, "un corps gras oleifiant," which, literally translated, would be a fatty body of the olefine type. What this means is known to every chemist. The term olefine is taken from the well-known olefiant gas, (or oil-forming gas), known also to chemists as ethylene gas. The name olefine, or as it is in French, "olefiant," is now applied to all the derivatives of this olefiant gas, and in this series we have for example the fatty body olein, and the free fatty acid, oleic acid, obtained from the decomposition of olein. On the other hand we have stearin, and a fatty acid, stearic acid derived from it which do not belong to this olefine series.

Now, of this class of oils we have a typical example in the vegetable kingdom of an olein, viz., olive oil. This exactly fills this description of a fatty body of the olein type, and at the same time it is the ordinary oil of Italy, in daily use as food, and sometimes as an illuminant. I am satisfied that in view of the limitations imposed in the claims of this patent, that wherever in the Italian patent ordinary oil is referred to he

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meant olive oil. It certainly could not mean petroleum residuum, as that is absolutely excluded by the wording of the patent claim.

I want to go still further on that exclusion of petroleum. If you take the original French of the claim, he has three words, ("Bitumes, goudron, napthe, etc.*)" and which have been translated, bitumen, tar and naphtha. It is in regard to the last that I want to say a word. The word naphtha is generally applied now to a fraction of petroleum, but in the past it was not so applied either in this country or abroad. When the oil development first began in Western Pennsylvania in 1859, the oil occurrences were always referred to as naptha springs, and the crude product was referred to as naptha. That is not, at the present time observed as a designation in the English language, and to illustrate that, I will read from Bacon's "American Petroleum Industry," which is a new and very complete book just published, and in the rear of this book we have a glossary of terms with the meanings, and I take the word naphtha, and I find as follows, in regard to it: "This term, which was formerly applied to any fluid, and volatile, variety of bitumen, is now generally applied merely to those petroleum fractions which boil below 280° F." That is, in American usage, it is no longer applied to a crude oil, but is applied specifically now to this light fraction; but in the foreign usage it is still applied to crude petroleum, and I have here a French technological dictionary, the title of which is "Tolhausen Dictionaire Technologique." This is a

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splendid work, which I have known for years, and in this volume we have the French word first, and then the German and then the English, and if I turn to the word "naphthe," which is found in the French patent, we find as a synonym for that, "huile de Petrole," or petroleum oil, or simply petrole. Then, as the German equivalent of the word naphthe, "erd-oel, Stein oel," and as the English equivalent, naphtha, rock-oil, petroleum.

I really believe, therefore, that we are perfectly justified in translating Froment's French language in an accurate way, and if we translate it in an accurate way we will see that that portion of the sentence inclosed in the brackets absolutely shows that, not only bitumens of all kinds, tar of all kinds, but also petroleums are named; and if we take with that the other showing in the claim of the patent, that he particularly prescribed a fatty body of olefine type, I think Froment has limited the kind of oil very distinctly for our benefit.

Now, we come to the quantity of oil. As before said the expression "a thin layer of oil" is not very definite. Dr. Liebmann, in the Miami case, in testifying stated that using olive oil, he found the amount necessary for a thin layer amounted to 12.5 to 15%, reckoned on the weight of the ore. If we take 10 grams, this would amount to 1.25 grams, or 1.5 grams respectively, of oil.

There is other testimony on this matter, however, in the Hyde record, volume 2, page 308, where William Henry Ballantyne, who testified, said as follows: "I frequently tried the Froment process in a test tube,

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and I found that a thin layer of oil amounts to not less than about 5% of the weight of the ore." I made a number of tests of my own to get a thin layer of oil, using olive oil, and I found that, according to the temperature of the water mixture, I was able to get a layer of oil which not only was relatively a distinct layer—more than a thin layer, looked at from the side—but I took it that the point which ought to decide the matter as to a layer of oil was looking at it from above, in regard to touching the circumference of the glass or test tube, and getting a layer of oil which completely touched the glass all around the edge, I was able to get a layer with a little less than 1 c.c. of olive oil when I used the lowest temperature, which was 25° C., and when I used a temperature of about 40° C., which is not very warm, I found that about .3 of a c.c. of olive oil completely touched the sides of the glass test tube, and therefore made a layer of oil which was a complete layer covering the whole of the water underneath. Therefore I assume that 1 c.c. of olive oil would be quite sufficient, even with a lower temperature, to answer the description of Froment as to the amount necessary to be used to form a thin layer of oil. Now, with the specific gravity of olive oil, which is about .9, that would give us 9%, reckoned on the weight of the ore; so I would be satisfied to call it 9%, which is rather less than was stated by Dr. Liebmann, and is rather more than was stated by Mr. Ballantyne, and 9% is quite sufficient to illustrate the experiment with.

We go now to the consideration of the steps of agi-

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tation. This is referred to in the Froment Italian patent in the test tube example and says "and the mixture then agitated for a second." The English patent, referring to the step, says "then agitated for a brief space."

Under these circumstances we may assume that the "second" is not to be measured to the minute fraction, but is an approximate measure for a brief agitation. I take it that the words "agitation for a second" is a figure of speech, meaning a very brief agitation.

As the experiment given by Froment in his example is carried out in a test tube, the agitation is most readily effective by closing the test tube containing the mixture with the thumb and shaking it momentarily, approximately a second or two. Now, the results.

The result of this agitation I find as it is stated to be, that the copper pyrite, that is, the metallic mineral, will instantly rise to the top of the liquid. That is the expression "will instantly rise to the top of the liquid."

Now, the appearance of this mineral which thus rises through the liquid to the top is then stated. It is not sufficient for us to understand that the copper pyrite rises to the top of the liquid; its appearance, and conditions by which it exists at the top of the liquid are clearly stated. "The metallic spherules, pressed against one another, will become grouped in a magma, clearly separated from the remainder of the liquid," and then of course the production of the gaseous froth, as a result of agitation. This froth, the gaseous froth produced, is unquestionably produced directly by the

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agitation; the agitation is the direct cause of its production.

A further statement of the result which follows immediately after is, that the small quantity of gangue, mechanically entrapped, gradually falls from the sulphides and the sulphides remain in a state of almost complete purity. Such is the principle.

Now, we have in this section, which gives an example of the working of the test tube experiment, a caution to the inexperienced in chemical manipulation; Froment says, "if the limestone is in excess, or readily attackable, the rapidity of the separation is so great that the copper pyrite is forcibly ejected from the vessel. Therefore, a correct proportion has to be given for a given ore and a given limestone." Now, it seems to me that that, taken together with the mention of the proportions and of the amounts of the different ingredients, is all that is necessary to enable one to entirely avoid a good deal of what looks to be to be simply illustrative of inexperienced manipulation.

That a test tube should be shaken and the whole of the contents thrown violently out and over against the wall is not a necessary result if we pay attention to what Froment has stated. It might happen occasionally, but I am satisfied that, if we take the statements made here, the decomposition of the limestone is going to be such as to instantly throw out the contents of the test tube.

In some of the previous experiments that I have read in connection with the testimony in this action,

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illustrating Froment, the amount of acid was distinctly taken fully equal to the amount of limestone. Froment does not indicate what that would do, or that we should take 1 gram of limestone and 1 gram of sulphuric acid. If he had meant to say so, he would have said so, and therefore, if we take his language and make our translation accurate, we can see what the minimum decomposition of the limestone would be, which limestone is here 10% of the ore. That amount is absolutely unnecessary, and it is not contemplated except as an accident, and as to the accident, of course, he has given a caution.

There is one other statement that we need to notice before going on to the claims of the patent; in connection with example No. 2 of Froment's Italian patent, which comes just before the claim. The statement is as follows: "There are several distinct but connected operations in the practical working of the process; the formation of the spherules and their separation from the gangue, then separation of the concentrate and the oil, and recovery of this latter for a re-entrance into the circuit of operations. The products of the concentration form oil cakes." The English patent simply says, "form cakes." I simply conclude that Froment at the time thought that there would be a possibility of his pressing his concentrate and recovering the oil. That is another matter, however, and I have not taken that up, because it does not illustrate the principle of the froth formation; the froth formation is entirely irrespective of whether he recovered the oil or did not

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recover the oil, and therefore I leave that for what it is worth.

The first of these operations, the formation of the spherules or gas-bubbles coated with a film of oil carrying metallic sulphides, and their separation from the gangue by reason of their rising to the surface of the liquid, where they form a dense metal-coated froth or magma, as Froment has called it, has been discussed already.

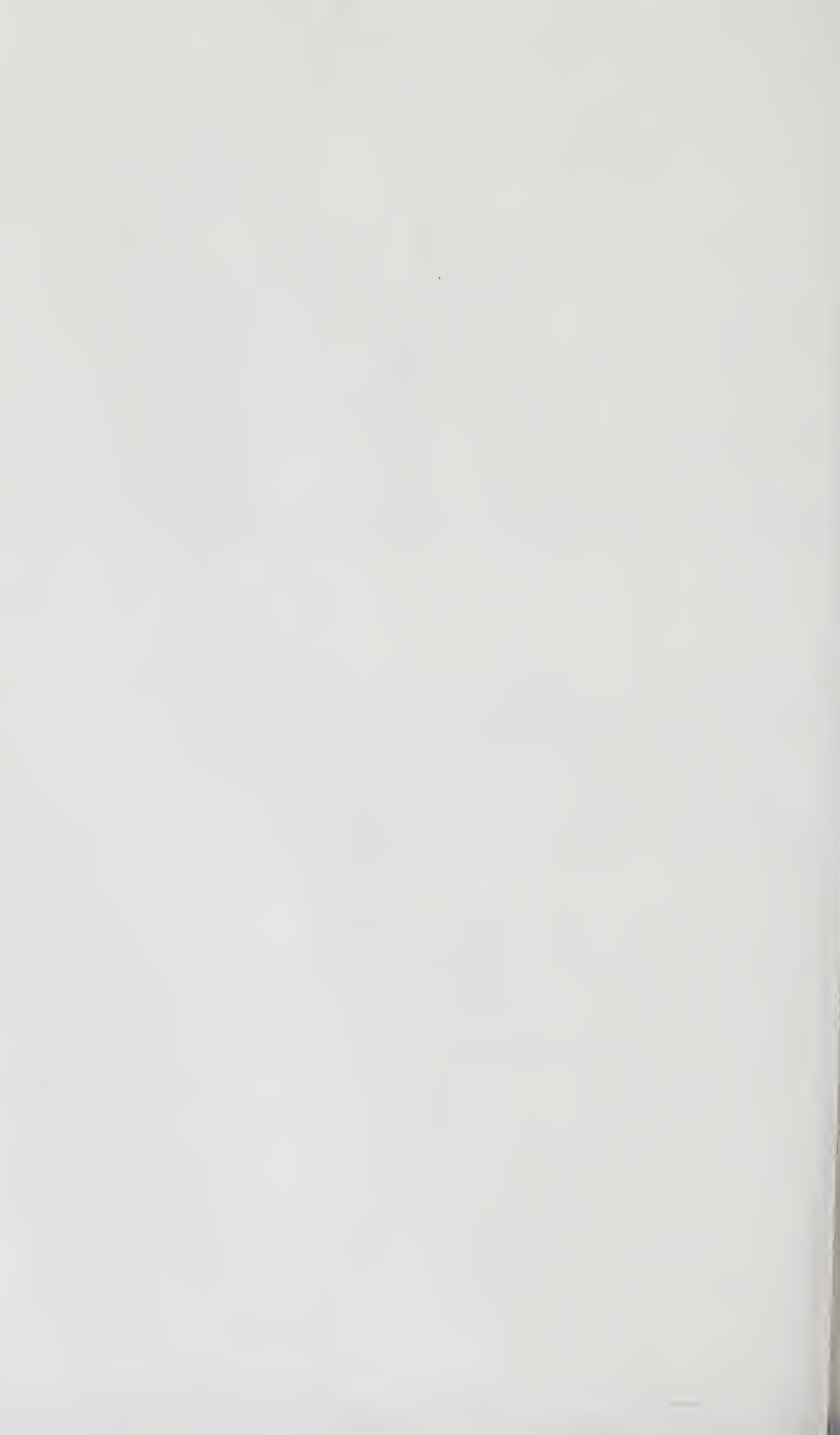
The other two relate to the concentrates already existing apart in the froth on the surface of the liquid. How these two latter steps are carried out he does not state here, and for light on this subject or his later development we have to turn to the Froment description, a document which was not published, and is not essential to the understanding of the principle.

I now come to the claim of the patent. I have already referred to it somewhat in speaking of the nature of the oil. However, as it is short, it will be well to give it in full.

"I therefore claim, as being my exclusive and entire property, a process consisting in enriching sulphide and other ores, graphitaceous ores and their derivatives, sulphide earths, or others, by means of gases, whichever they may be, combined with a fatty body of the olefine type, and not with an oily body derived from bitumens, tar, petroleum, etc., and whatever may be the apparatus in which the process could be applied."

Before commenting upon this claim, which is very broad, let us compare it with the claim of the corre-

P. 3627, L. 13, insert " the clear intent of certain features
of " before " the invention "



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sponding English Froment patent, No. 12778, of 1902. The wording there is as follows, found in the Hyde record, page 787.

“The herein described process for the concentration of metalliferous ores and earths, which consists in commingling the finely powdered ore or earth with water, and adding a suitable oil, and then liberating a gas in the mixture, substantially as described and for the purpose specified.”

This is condensed, but it is condensed at the expense of clearness of statement, and involves the omission of the invention, viz., the defining of the kind of oil to be used. In several points, also, I consider that the wording of the English patent claim is less explicit; there is, in addition to this matter of the character of the oil—for instance, the Italian claim is for a process to enrich sulphide and other ores, graphitaceous ores and their derivatives, sulphide earths, or others.” While the English claim is for a process “for the concentration of metalliferous ores and earths,” without qualification. It is broader, obviously, but it is less informing and less definite.

(Recess.)

THE WITNESS: I was speaking of the points of difference between the claim of the English patent and the Italian Froment patent. I stated that the English patent claim was distinctly less explicit in several respects. This view is not solely my own, but is shared by Dr. Liebmann, one of the experts who testified on one of the former trials in connection with this process

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in Patent 835120, and I find in the Hyde record, Volume 2, page 460, Dr. Liebmann's expression about this same thing as follows: "The Italian specification precedes the English one by a short time, and the English is clearly a translation of the Italian document, with such slight alterations as a translator who is a British patent agent would make. There are some mistakes in the British document, which cloud the true meaning of the original, to which I shall refer later." Dr. Liebmann pointed out also, as I have done, some distinct points of difference. In my mind the most important point of difference by far is the absolute silence in the claim of the English patent as to the character of the oil which Froment desired to use. The term "suitable oil" is utterly inadequate in view of what appears in the Italian patent, in which Froment quite distinctly and specifically limited the kind of oil which he had desired to use.

On the other hand, the English claim indicates the general method of the operation described better than the Italian claim. The English claim, for instance, says: "It consists in mixing the finely powdered ore or earth with water, adding a suitable oil, and then liberating a gas in the mixture, substantially as described and for the purpose specified," while the Italian claim does not give these steps, but merely claims "by the means of gases, whichever they may be, combined, with an oily body of olefiant type." The Italian patent claim therefore does not tell us how the co-operation of the gas and the oil is to be effected;

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but while that is wanting in the Italian claim, the information contained in the specification and example of the Italian patent are perfectly adequate to supply that information; the information is quite complete if we take it from the specification, including the phenomena as stated, and the example.

Now, we come to the nature of the gas which forms the spherules in Froment in the example given in his Italian and British patents. In the Froment Italian and British patents, the test tube examples given quotes 1 gram of limestone to 10 grams of ore and a few drops of sulphuric acid. I have already shown that this amount of sulphuric acid is insufficient to decompose the calcium carbonate of the limestone. The amount mentioned in the patent of 10% of limestone relative to the ore was too much, and that is also intimated by Froment in the same paragraph, where he says "a correct proportion has to be found for a given ore and a given limestone," which shows us that he did not wish to intimate that the reaction required uniformly the same amount of limestone; and later, when he comes to furnish his description, he goes into that subject much more fully, and gives the amount of limestone relative to the amount of ore, which is very much less than is here stated in the example.

In the Froment instructions to which I just referred 1%, or in different cases a maximum of 2% of limestone is stated to be the correct amount, as against the 10% which is to be given in the example. The sulphuric acid added in the second stage of the operation

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described in Froment's instruction is calculated to exactly correspond in that case in weight with the calcium carbonate, which is essential to effect the complete decomposition.

Coming back, however, to the test tube experiment of the Froment patent, what is the nature of the gas which inflates the metallic spherules which rise to the surface on agitation?

It has been assumed that it is essentially, if not entirely, carbonic acid gas. I think a little reflection will show that this can not be the case. We start with a test tube containing 10 grams of ore, one gram of limestone, 30 grams of water, a thin layer of oil, and a few drops of sulphuric acid, insufficient in amount to decompose the amount of limestone present. The rest of the open space in the test tube is of course filled with air. We close the test tube and shake up vigorously for a second. The volume of carbonic acid gas liberated, corresponding to the partial decomposition of the limestone by the few drops of sulphuric acid, is small. Remember, now, that under normal atmospheric pressure, one volume of water will retain, dissolved, its own volume of carbonic acid gas, so that it is only the excess over this volume that is free to escape and mix with the air which is being entrained by agitation. The mixed gases which form the froth or magma of metallic spherules, it is plain, must be predominantly air, with a relatively smaller amount of carbonic acid gas, which will inflate the air bubbles, or gas bubbles, we will call them. The mixture of gases, therefore, which form the froth or magma, it is plain,

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will be a mixture of carbon dioxide and air, and predominantly air, with a relatively smaller amount of carbonic acid gas.

Dr. Liebmann, a former witness, has testified in the Hyde record on this matter in volume 2 of the Hyde record, page 557, as follows:

"I pressed the lower end of the thumb on the test tube, and shook first for two seconds, what one might call violently. Then I made an observation, and after that shook again for 6 or 8 seconds. The amount of carbonic acid which could have been evolved was so small that it would have been dissolved in the water which was present. It requires over 7 c.c. of water for the solution. From the experimental evidence and from my experience, I have grave doubts whether carbonic acid would evolve at all."

I would not go quite that far. I think carbonic acid is evolved, as far as my experiments in the test tube have shown, but I will agree with Dr. Liebmann that the amount of free carbonic acid gas, which is residual, after the reaction and which can mix with the air already contained in the vacant space in the tube, is small in amount, and therefore the conclusion is readily drawn that we would have a mixture of carbonic acid and air, in which the air is certainly two-thirds or three-quarters of the mixture. That would make it accord with the proportion of the mixtures which have been produced under the processes of the patent in suit when they were operating with ores relatively rich—containing say five to six per cent of calcite. Dr.

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Liebmann has testified in that connection as to the analysis of the mixture of gases resulting from the operation with the San Francisco del Oro ores in Wales, where he found as a composition of the gases inflating the froth produced by the operation of the patent in suit, $77\frac{1}{2}\%$ of air and $22\frac{1}{2}\%$ of carbon dioxide. I do not believe that if we carry out the test tube experiment of Froment, using the proportions that have here been stated, that we will have as the composition of the gas mixture anything very different from what is there stated to be the composition of the gas mixture inflating the froth produced by the patent in suit. It must be remembered that we also have in the Froment Italian patent the claim, "by means of gases, whichever they may be." And we must remember also that the patent in suit, No. 835120, says, page 1, lines 91 to 94: "A froth or scum which has derived its power of flotation *mainly* from the inclusion of air bubbles introduced into the mass by agitation."

"A froth or scum which has derived its power of flotation—" I didn't quote it correctly before—"A froth or scum which has derived its power of flotation mainly from the inclusion of air bubbles introduced into the mass by agitation." We find, therefore, that a gaseous mixture is possible and is allowable by the language of these two patents, in either the case of the Froment or the patent 835,120. The Froment description which became public later need not be discussed in the same way that we have discussed the two patents in which Froment made known to the world his dis-

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covery and clearly enunciated his understanding of the principles therein involved, and made his broad claim. The description, with accompanying drawings shows a two-step process instead of a single step process as given in the example of the patent, Italian and British. We have in the Froment description—

MR. SCOTT: Page 730, volume 3, of the Hyde record, that is the translation of it.

A. 730 of the Hyde record, volume 3; the description with accompanying drawings shows a two-step process instead of the single step process given in the example of the patent. We have a centrifugal mixer for the ore pulp, limestone and oil, in which there is an energetic agitation which, from the construction of the stirring devices, entrains air and forms an aerated froth. The stirring devices are shown there in the dotted lines which are to revolve in "a," centrifugal mixing device, by the revolution of this stirring device we have the same vortex ^{for} of motion generated, and the entraining of air with the formation of an aerated froth. This, however, is discharged without being allowed to separate, discharged into a vat with leaden coil for the introduction of sulphuric acid and steam, and with a horizontal rake to be slowly revolved after the introduction of the sulphuric acid, and thus gives a supplementary gas-bubble development for the purpose of raising additional mineral not already in the froth formed at first. The only radical difference is that the sulphuric acid comes into the operation in the

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so-called coil vat. In the test tube experiment, it is all done momentarily and in the reaction of the sulphuric acid in the test-tube experiment we of course have an actual reaction of the sulphuric acid on calcite; but the brisk agitation gives us the shaking up of a large volume of air in the test tube with the watery pulp and oil globules and the entraining of the air with the incidental amount of carbon dioxide is accomplished in this way. The accomplishment of the result is rather different in the process described in the Froment description. A Froment machine built upon the description and built to operate as here figured I have seen operated repeatedly and I have seen results obtained from the same which gave an excellent froth, as a result of the first operation, supplemented by a small additional amount of froth by the operation of the sulphuric acid acting on the limestone in the water.

Q. 184. Do you wish to illustrate the Froment patent?

A. I would like to have the test-tube experiment shown. (Test No. 37.)

MR. SCOTT: Do you want a sample, Mr. Williams?

THE WITNESS: This is Butte & Superior ore we are talking about in this case, 10 gms. Butte & Superior ore and 1 gm. calcite.

MR. WILLIAMS: About two-fifths of an ounce, isn't it?

A. I don't think in ounces very quickly. We add 30 c.c. of water.

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Q. 185. MR. WILLIAMS: At what temperature?

A. 37° C. 2 drops sulphuric acid and one cubic centimeter of olive oil. 1 c.c. was the full limit that I thought necessary. That makes 9 per cent.

Q. 186. MR. SCOTT: Does the oil form a layer, doctor?

A. It does form a layer.

Q. 187. Over the entire contents?

A. Yes. I verified that before. Now, that is the one second, used as a figure of speech, for the production of froth, which is merely an air froth. There was pressure as can be seen by the fact that it squirted a little bit there. A slight additional agitation will continue the result. (Agitating the test tube again.) We have there now three-quarters of an inch of froth. And that gives us all that was described by Froment, metallic spherules pressed together closely forming a so-called magma which to all intents and purposes, looked at from above, has all the appearance of the froth which had been produced by other modes of agitation. We have there the clear metallic coating, the spherule formation and appearance and everything that has been described. That has become quite pronounced now, it is quite dark. Of course this a zinc ore. With a copper ore the distinction in color is even sharper.

Q. 188. And do you plan an experiment in the Gabbett of the California Journal process?

A. Yes.

Q. 189. We might do that now.

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A. An experiment has been arranged for to illustrate the procedure of the California Journal of Technology which was to produce the foam effect by utilizing a form of mechanical agitating apparatus to produce the froth effect, which was quite well known from 1889 on and of course known in 1903 when this article was published in the California Journal of Technology. I refer to the Gabbett cone mixer which was patented in England in 1889 and patented in the United States in 1891, which was 12 years before the appearance of the California Journal of Technology. There is being used here a copper ore. The California Journal of Technology referred to there tells of copper ores as well as the tests with the molybdenite. The quantitative results which were given in that publication refer to molybdenite, but it was also tested with copper ores as stated by them, but not quantitatively. We have 250 gms. of copper ore, chalcopyrite ore.

Q. 190. You might describe the different ingredients.

A. With 250 gms. of this chalcopyrite ore we take 1250 gms. of water at a temperature of 25° C., 13¼ gms. fuel oil, California fuel oil, a paraffin product, which is equivalent to 5.3 per cent relative to the ore. The foam effect was obtained by these students who published this article with varying amounts of oil relative to the ore as low as two and a fraction of a per cent up to nine per cent. 3 c.c. of concentrated sulphuric acid. Sulphuric acid was used by them as well as salt solution in their experiments in producing the

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foam effect. The agitation will take place in the Gabbett cone machine, five minutes agitation. All of the elements which are here present in this experiment are justified by the statements made in the California Journal of Technology or by the knowledge which was available at that time.

MR. WILLIAMS: Just note that the temperature of the water was 25° C.

A. I have that; I read it a minute ago. We are endeavoring to get the exact amount of the fuel oil by weighing, by difference in weight, weighing the beaker containing the oil and pouring a certain amount in and then weighing the beaker again and then taking the difference in weight as the amount taken. (Test 38.)

You can see the result of the foam produced after the California publication.

THE COURT: What was the oil?

A. The oil was 6.1 per cent instead of 5.3 per cent, as they added more than they intended to.

MR. WILLIAMS: I think we ought to have the tailings for assay if any assay is made because we cannot see them in this machine and don't know what their color is. If possible, let the tailings be assayed as well as the froth, so as to get some idea of what the operation has accomplished.

MR. KREMER: Do you want a sample of it?

MR. WILLIAMS: Yes.

THE WITNESS: While that is being gotten I would like to say that the California Journal of Technology published in that issue the basis for all three

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experiments. Two of them have been standing upon the desk here in sight for a week or more.

Q. 191. Since the day which the record will disclose?

A. Yes. One with a dilute sulphuric acid and the other gotten in a salt solution with an amount of oil corresponding to that stated in the publication and gotten by agitation only in the tall cylinders, and illustrating what was there called the foam effect. In this third experiment we have taken the same ingredients and have gotten the foam effect in the form of a definite froth, which is, however, no more definite than what was shown there by putting—

Q. 192. (Interrupting.) That which is shown in the cylinders?

A. No more than what is shown in the cylinders by applying mechanical agitation instead of the mere shaking, the form of apparatus being one which was quite well known, in fact had been patented in this country 12 years before the publication of the California Journal of Technology paper.

Q. 193. Do you know, doctor, of any other apparatus suitable for that purpose that was also known at the time of the issue of this California Journal of Technology?

A. The Johnson cone mixer was also known.

Q. 194. Can you refer us to anything that shows that in this record of the Hyde record, which is in this case?

THE COURT: It seems to me I saw a churn in the Hyde record too.

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MR. SCOTT: Page 966.

A. The Johnston cone mixer, as it is called, is illustrated in the Wolf patent which appears as patent No. 78,814, page 966 of this volume 3 of the Hyde record.

MR. WILLIAMS: Page 966 of complainant's record is the Wolf patent.

A. The Johnson mixer as it is called, which was shown in the Wolf patent was referred to by Mr. Henry L. Sulman in the Hyde record, volume 1, page 274, in answer to cross-question 149 on that page: "You have said that this Johnson mixer was well known at the time of the Wolf patent. I note that the patent was issued on April 6, 1905, upon an application filed in May, 1903. Did you intend to include one or both of those dates in your answer? A. I intended the earlier date. Mr. Sulman testifies that this Johnson mixer was well known in May, 1903. The California Journal of Technology appeared in November, 1903, six months or more after the time at which Mr. Sulman testified the Johnson mixer was also well known. We have there two very efficient mechanical forms of apparatus."

Q. 195. Explain the apparatus while we are on this subject?

A. I would rather refer to that again in my other testimony. I will come back to that.

Q. 196. Just as you please, doctor.

A. I have nothing more to say on the Froment at present.

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Q. 197. Then, doctor, suppose we get your idea on the Kirby process, shown in the Kirby patent 809,959.

MR. WILLIAMS: Patent printed on page 738, defendant's record in the Hyde suit.

A. I think next—

MR. SCOTT: Doctor, before you go on, I can't remember whether you commented upon this froth, and told us its appearances and structure?

A. In a general way only.

Q. 198. I would like to have it.

A. The froth produced by this experiment with the Gabbett cone mixer and intended to illustrate the publication (procedure) of the California Journal of Technology, is a very decided mineralized froth possessing the heavy mineral coating which has been seen in similar froths produced by other processes, and I am satisfied from the corresponding experiments made simply by the shaking in the tall cylinders that the froth here obtained will be a very durable froth. It is of course as seen now a distinct separated froth. The liquid below is clearing rapidly and we cannot see the tailing, but I have no doubt but what the distinction will be very sharp between the froth and the tailings; and therefore it is to my mind as complete a separation under the influence of aeration by agitation as is ordinarily accomplished by following the process of the patent in suit.

Q. 199. How would you say that the structure of this froth compared with Professor Bancroft's definition of an agitation froth?

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A. I can see quite clearly the appearance of the rounded cells, which of course are filled with air, and the walls of which are of thin layers of oil in which ^{cell} walls have concentrated the mineral sulphides, thereby stabilizing the froth, and in every respect corresponding to the description of what a froth is composed of. The peculiar physical appearance of the froth, that is, the pitted structure, and the other characteristics which we become acquainted with by the photographs are also quite noticeable in this froth.

Q. 200. I think you referred to the fact that the authors of this California Journal of Technology described particular experiments in which the quantity of oil ranged from two and a fraction up to eight or so?

A. Nine.

Q. 201. I presume in view of that you do not consider it material that a little over six per cent of oil was used in this experiment instead of 5.3 that I think that you planned to have used.

A. No, the only material feature is we kept within the range which is indicated there in that California publication and it is distinctly above the range which is claimed in the patent in suit.

Q. 202. Now, doctor, after this interruption you may go on?

A. I will turn to the Kirby patent, United States Patent No. 809,959, patented January 16, 1906, application filed December 14, 1903.

We can best understand the Kirby patent, what it means and what it achieves by taking his statement of

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steps as given on page 1 of the patent, beginning with line 65: "The process, as an entirety, in its best form for use with Rossland ores for the purpose stated consists in the following steps: First, in thoroughly agitating together (a) the pulverized ore or mineral material; (b) enough water to make with said pulverized ore a flowing pulp, and (c) a solution of bitumen in a thin distillable hydrocarbon liquid as kerosene, these materials to be so thoroughly agitated together as to finely subdivide said solution into small globules and bring said globules into contact with substantially all of the pulverized mineral particles which will, by preference, adhere to them."

THE WITNESS: This is the first step, which they have described, the agitation. Now, we will note with regard to this agitation that Kirby speaks here of thorough agitation. The term "thorough agitation appears twice in this paragraph which has been quoted from his patent specification. In several of his claims, notably in claims 1, 2 and 3, he used the expression "violently agitated," as applying to his first step of the process;—violently agitated. Now, Kirby's agitation or mixing tank is shown in Figure 1. There are four figures attached to this Kirby patent, and in Figure 1 we have shown Kirby's agitation or mixing tank at the extreme upper left hand corner. This agitating device is described on page 3 of his patent, line 100, as follows:

"In the mixing tank a vertical rotating shaft A

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is mounted having, preferably, a lower bearing similar to that which is provided for shaft B, and which has been described. Arms A¹ are attached to the shaft near its lower end, and lifting plows are secured to the outer parts of these arms, and radial plows to the other parts thereof, just as in the separator tank. This shaft A is to be rotated rapidly, and the result is a sort of commingling of the various parts of the charge, which result is facilitated by the currents created in the charge by the action of said plows, the direction of said currents being indicated by the arrows in Figure 1.

We have noted there the arrows, and it shows that the liquid is rising near the outer circumference of the tank, and apparently descending along the central shaft on either side. That is a clear diagrammatic illustration of the vortex motion obtained by this machine. The vortex motion is there illustrated by the dotted curved line, illustrating the upper surface of the liquid, which is shown there curving inward to the center. When the rotation is kept up that can be quite easily seen in all these mixing devices, for instance like the Gabbett mixer and many others we have these radial arms rotating. We have here indicated not only the direction of the vortex current by those arrows, but also by the dotted lines in these liquids, showing the same drawing down of the liquid which takes place in the Gabbett cone mixer.

Now, this necessarily involves the drawing in of air with that motion; you also get some entraining of

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the air as practiced in the Gabbett mixer described in the first step of the patent in suit.

Kirby tells us practically that shaft A is to be rotated rapidly, and insists in his claims, on violent agitation in connection with this first step. Moreover, I would call attention to the fact that Patent 809959 is for a process, and his illustrations are merely for the purpose of showing the way in which the process can be carried out. This is clearly stated by him in lines 26 to 29 on page 1, as follows:

"In the drawings, Figure 1 is a diagrammatic view of an apparatus with which the process may be practiced, the several parts thereof being shown in vertical section."

At the time of the application for the Kirby patent, two other mixing devices adapted to produce aeration by rapid agitation were well known and available; one of them has been referred to just recently, the Johnson mixer, in patent 787814 to Wolf. Mr. Sulman has testified in regard to this in defendant's record in the Hyde case, page 274, first, that this Johnson mixer was designed to produce much the same effect as the Gabbett cone mixer. I would like to refer to that and verify it. Mr. Sulman testified as follows: "The apparatus was designed to produce much the same effect as the apparatus generally known as the Gabbett or cone mixer. In this instance the radial arms supporting the inner tube acted as efficient baffles, preventing the undue rotation of the liquid as a whole."

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Now, that is best understood if we refer to the Wolf patent and see what he meant by radial arms at the sides. In this Wolf patent, the values of the radial arms is there referred to, and Mr. Sulman says in regard to them, that the radial arms supporting the inner tube act as efficient baffles; in other words, the rotating liquid starting to rotate by this rotating device here, is broken constantly by those baffles, or those arms acting as baffles. Mr. Sulman also states, in answer to the next question following, that this Johnson mixer was wellknown in May, 1903.

The other aerating and agitating apparatus was the Gabbett cone mixer, which was patented in England in January, 1889, and patented in the United States in January, 1891. I have already referred to the fact that both of these dates, the date of the patenting of the Gabbett cone mixer and the date of the knowledge of the Johnson mixer as testified to by Mr. ^{Sulman}~~Sullivan~~—that both of these dates were prior to the California Journal publication dates.

Now we come to the consideration of the Kirby patent—We come next to the results of this first agitation step. The result of this first thorough or violent agitation is stated in lines 109 to 114 on page 3: "This shaft A is to be rotated rapidly, and the result is a thorough commingling of the various parts of the charge, which result is facilitated by the currents created in the charge by the action of said

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plows, the direction of said currents being indicated by the arrows in Figure 1."

As I have just explained, these currents constitute a vortex, which, with the rapid agitation, must involve the entraining of air. The second result, however, is stated by Kirby on page 1, line 79, as follows: "In allowing the hydro-carbon coated particles to float to the surface of the mass, and in rendering this separation substantially complete by gently agitating the mass and by injecting gas into the same, and preferably also discharging into the mass fine streams of the solution. When the separation is completed, the floating hydro-carbon concentrate is removed for subsequent treatment."

The statement of the results that the hydrocarbon-coated particles float to the surface of the mass, means that they are there as a part of a froth on the surface of the air bubbles developed by the entraining of air in the rapid motion followed by the vortex action of the liquid, with the air bubble production.

There is only one conclusion, as I say, to be drawn as to what this float was; this float could only have been an aerated froth, coated with mineral particles. Now, it has been shown experimentally in two experiments already in this case here in court—It was shown by Mr. Phillips in producing the product obtained with 25% kerosene in the small glass jar, the remnants of which are there on your honor's desk, and it was shown by Mr. Dosenbach in a larger glass jar, using the proportions of this kerosene indicated by

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Kirby—in other words, these experiments made in connection with this trial have illustrated what I am here describing as the necessary result of the several steps of agitation given by Kirby in his patent.

Now, we get to the second step. The second step is clearly stated to be a secondary, and not a primary part of Kirby's process. In the language of the patent, page 1, lines 81 to 85, after what I read in regard to the floating to the surface of the mass, it says, "And in rendering this separation substantially complete by gently agitating the mass and by injecting gas into the same and preferably also discharging into the mass fine streams of the solution."

Again on page 2, in lines 44 to 48, the same matter is referred to as follows: "The introduction of a gas, preferably air, into the mass, which is the additional novel characteristic of the second step of this process, assists in the flotation of the hydro carbon coated particles." Notice the word "assists".

The character of the second step as a complementary step is clearly illustrated in these two citations; as steps to make more complete the original froth separation, and this secondary process is characteristic of practically all agitation processes, and is very clearly stated in the patent in suit, as desirable.

Kirby says again "the invention consists in the process hereinafter described and in the several steps thereof, all of which will be definitely set forth in the claim." We have a clear recognition of the fact that there is a primary and a secondary step, and the two

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may be taken as individual steps, combining to get what he considers to be a more complete rising of the particles and accomplishment of his result.

Again, on page 1, line 95, the matter is referred to. Kirby says, "The use of a gas to assist in the flotation of the coated particles, as set forth in the description of the second step of the process, is radically new in this art, irrespective of its association with the other steps described." There is another statement which appears shortly after that, which I think is a gratuitous statement, not connected with the description of the process, but which sometimes is considered as having a very notable bearing upon the process. I wish to call attention to that:

Kirby's suggestion in line No. 102, that his second step could be used advantageously in connection with the prior processes using thick, viscous oils, to prevent the flouring, has nothing to do with the present invention, and in view of the first step, it can not be. It was evidently a bulk oil process to which he was referring.

As to this view of Kirby's that the use of a gas would be a good thing in connection with the thick viscous oils, that is a supplemental step, and it is not necessary for me to say whether I agree with Kirby as to that or not, because I have not tried that idea, but it has no connection whatever with the clear-cut, two-step process which is described by Kirby, the first step and the second step.

Whereupon further hearing was adjourned until Thursday morning, May 3d, at 10 a. m.

Thursday, May 3rd, 1917, 10:00 A. M.

MR. GARRISON: From evidence recently adduced by the defendant in this suit, we have been convinced that in addition to infringing the patent which is pleaded in this suit, they have also been infringing another patent owned by the same plaintiffs, which we know colloquially as the soluble frothing agents' patent No. 962678 of June 28th, 1910. We purpose filing a bill to protect our interests with respect to that patent but it occurred to us that since Mr. Scott and Mr. Sheridan are thoroughly familiar with all of the issues that can arise under that patent because in their defense of the Miami Copper Company during the nine weeks' trial at Wilmington and the six days in the Court of Appeals at Philadelphia that patent was one of the points in litigation and all of the evidence was minutely gone into and briefed and debated, that they would perhaps prefer to have us bring that patent into this suit and join issues upon the question of our right under that patent in respect of their acts and try that out at this time. If they so elect and are ready to join that issue now and to proceed with this trial, we are willing to adopt that course. Otherwise we shall pursue by an independent bill the right which we have to litigate that question by itself. I will give them the opportunity if they feel it would be a better service of their interests, to have litigated in this suit now, to have them elect so to do and we will then adopt that course.

THE COURT: Of course there is no reason why such a proposition in court should embarrass counsel

and yet personally I am always reluctant to see such things broached in court for fear counsel may be misunderstood. If there are any negotiations or any proposals of that nature they ought to be taken up with counsel, it seems to me, rather than with the court.

MR. GARRISON: The reason this matter is brought in open court, your honor, if the defendants in this suit ^{had} ~~at~~ any purpose to claim that it would have been a better proceeding for them to have this other question litigated in this suit, we now give them that opportunity. We do not want to embarrass them and I do not care whether they make any response or not. I simply wish to give them the opportunity now in open court to elect to have that issue tried in this case, if they so elect. If they do not so elect, that is a matter for them to determine, and if we consider it is necessary to save our rights we shall do otherwise. I should not have embarrassed the court with this although I do not wish to be fronted in this or any other court with the suggestion from them that they would have welcomed that issue in this suit, because it is a fact that a very great deal of the testimony with respect to the prior art at least—well, with respect to any infringement also, that is relevant in one case will be relevant in the other. It may be that when the other case is called for trial if I had not made this statement they would have said, "We would have preferred to try that question in the other suit."

THE COURT: Oh, well, if it wasn't a splitting up, that wouldn't count for anything.

MR. KREMER: Does this all appear upon the record in this case, if your honor pleases?

THE COURT: If, as he says, he conceives he is protecting his right, it possibly should.

MR. KREMER: I don't like this constant colloquy, but if that is so we desire to make this statement: that this is the first time that we have ever heard any intimation or suggestion of this sort; it was not made to us outside of court; neither has it been mentioned before in court.

THE COURT: Well, I think anyhow any right that is to be preserved, would be preserved by offering such a bill or by a modification possibly.

MR. SHERIDAN: While I do not like to cast any aspersions on counsel, but it is very cleverly put. I have refrained from making any remarks to the court at all. These gentlemen know that a defense to this patent is absolutely different from the defense to the patent in suit. We haven't a word in evidence that would controvert the validity of that patent, that would controvert its being an invention, or that we did not infringe it, and to bring that and put it into court would mean an adjournment of this court so that we could prepare our witnesses, four or five weeks. The gentleman that made this motion has had vast experience in court and knows how absolutely impossible that would be.

THE COURT: Well, I suppose there is such a thing as strategy, but it does not count for much before the court. If it was before a jury it might be different. That is why I say I like these things

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to come up out of court. Of course I do not criticise counsel. You have your view and so has he, and let's give you both credit for good faith, and as it is you may proceed with the case on trial.

DR. SAMUEL P. SADTLER resumed the stand
for further

DIRECT EXAMINATION,

BY MR. SCOTT:

THE COURT: I wish this morning, since the court has on two occasions rather strongly intimated—and that is often done to draw your fire—to ~~say~~^{Say}—that it can not see the likeness between this machine in the Fryer Hill publication and the Everson process and the one in suit—Dr. Sadtler has said that he understands that process and I would like him to go into that a little more fully and explain it. He is speaking now as an expert. I don't want you to feel restricted because I have already expressed a tentative opinion.

MR. SCOTT: Very well, sir.

Q. 203. Doctor, will you take that up right now?

A. Perhaps I had better finish the discussion that I was in the midst of as to Kirby, and then take it up.

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Q. 204. Well, you had better go into it right now I think, and show the machine.

MR. SCOTT: The Fryer Hill publication is in complainant's record page 738, and the Everson patent is in defendant's record page 607.

THE COURT: It seems to me to be recognized or conceded by both parties that this Fryer Hill publication had reference to the Everson process.

MR. SCOTT: That was conceded in the Hyde record.

MR. WILLIAMS: It was not conceded, if your honor please.

MR. SCOTT: The expert testified to it—I will correct myself; the two experts for the plaintiff testified that the operation described in the Fryer Hill publication was evidently an application of the Everson process, Dr. Chandler, and Dr. Liebmann.

MR. WILLIAMS: I think the substance of that testimony was this: in the Fryer Hill publication there is a reference to the use of sulphuric acid. In the Everson patent there is a reference to the use of sulphuric acid. There is no other resemblance between the two.

THE COURT: I had not noticed the difference or the resemblances, but I had that impression, that both parties were treating it as an illustration of the Everson patent.

MR. SCOTT: I will quote the testimony later, so as not to delay looking for it now.

MR. WILLIAMS: There is no positive evidence

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connecting the two; it is a mere matter of resemblances; it must be treated as two separate publications, each standing on its own legs.

MR. SCOTT: That is a matter of the evidence.

THE COURT: Yes, you can argue the evidence later. I wanted to be clear in my conception.

Q. 205. Have you the Fryer ⁷²² publication before you, Doctor?

A. I have.

Q. 206. Now, without reading through this, I would like to refer to the first passage descriptive of the machine that was used.

MR. SCOTT: Near the bottom of the page, if your honor please, about four lines from the bottom of page 738, it is stated that after the ore is prepared, after it is crushed and rolled to such a degree of fineness as to enable it to pass through a 40 mesh screen, the ore, dry, is thoroughly mixed with oil, after which it is placed in a circular tank or receiver⁷—which was represented by the glass vessel we had here, which seems to have been taken away but will be brought back.

THE COURT: Yes, I have a plan of it.

Q. 207. Now, Doctor, I think the best way to make it clear to the court would be for you to take the chair, where you can point out to the court on the drawing there, and you may place letters on the drawing as you go along so that in the record it will be apparent what you refer to, unless the drawing is already lettered.

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A. The first element in the apparatus described is the circular tank in which the mixture of ore and oil, previously made, is introduced. The ore while dry, is thoroughly mixed, after which it is placed in a circular tank or receiver. Here we have represented the circular tank or cylinder, this being an outline of it. This is the vessel of glass which has been taken upstairs and will be brought here in a moment; that is the containing vessel. Through the center of that cylinder runs a rotating hollow tube down here. This runs up, and here is the pulley by which the rotation is effected. This rotating hollow tube—there is a perforation which we will mention in a moment, but it is a hollow tube running down to where this door is attached. To the bottom of which tube is attached on two opposite sides a couple of fans. That is what we mean here, the fans. I will go presently to the apparatus and follow it there, but for the moment I am following it on the drawing. These are the two rotating fans, the lower edges of which are unevenly cut, in order to send the lighter particles of the ore and the lighter mixture to the outer side of the drum or cylinder. By rotation of this tube driven by the pulley, these fans are rapidly rotated, and by the aid of these serrations down here there is a very thorough mixing and churning again of the ore pulp and oil mixture, because we have now present the mixture of oil and ore which has been prepared, and the added water. The lighter particles of the ore and oil mixture are sent to the outer side of the drum or cylinder.

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This rotating hollow tube is perforated at or near the bottom. Here is the perforation. When the receiver is thoroughly charged and rotation is begun, acidulated steam—sulphuric acid being used—is introduced through the tube. This tube being hollow, allows of that introduction, passing out through these perforations, of acidulated steam. Now, that has a very distinct influence on the separating results; it gives the heat desired, and it gives the notable action of the acid which was referred to by Everson as one of the features of her discovery that, in the presence of mineral acid or mineral salts, for that matter, the selective action of the oil for the mineral is more pronounced and the separation of the mineral and the gangue is more perfectly accomplished. Steam is introduced in the tube and is forced to the bottom of the mixture while the arrastra-like fans—which refers to the construction and appearance of these two rotating fans—arrastra-like. It does not mean that they are to be worked as an arrastra would be worked; they are arrastra-like in shape and in their general appearance, but it is very obvious from the accompanying description there that there is where the resemblance ends. These arrastra-like fans are rotated rapidly, and keep the whole mixture in motion, and the action of the revolving tube, the fans, and the introduction of the acidulated steam—now we have the effect—causes the lighter portion to float to a point just above the center of the receiver. The float is formed here, and that float is an aeration froth

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formed by the rapid rotation of a form of apparatus calculated to produce the vortex motion, and calculated to introduce air from above, and thereby entrain air, and the entrained air furnishes the air bubbles, and the mineral particles concentrate in the film of air bubbles and gives the mineral-charged froth, if we take the aggregate of the air bubbles—to congregate slightly above the middle of the cylinder. It says “float to a point just above the center of the receiver.” The word float is expressive; that arises and remains as a floating froth or scum—to a point just above the center of the receiver, where there are suspended two semi-circular doors. In the beginning of the operation these doors hang vertically, as we will see in a minute with the apparatus, and their only influence in the early part of the operation is to act as baffles, because it can be clearly seen by the inspection of the special apparatus that has been presented, that a suspended or fixed vertical plate, or a fixed vertical wire frame as seen in the Gabbett cylinder apparatus, will act as a baffle to break up the continuous rotating motion, and thereby to thoroughly aerate, because the breaking up of the continuous motion is what causes the drawing in of air, and a thorough mixture,—and the thorough mixture is accomplished by the aid of these baffles, as well as entraining.

Now, these same semi-circular doors, after this float has formed, are just in the proper position so as to be raised, and they are drawn up so that they

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close and form a floor as you might term it, just under the float. I have carefully observed the operation where it was carried out in that apparatus, and I was able to recognize that the floor produced by the drawing up of the two semi-circular fans came very exactly under the level of the float which was desired, and when the oil passed above that, lifting its precious freight burden—that is, there is the float with the oil and its precious burden—then that will cause a water drainage through the perforations in the doors. The perforations are very small, and I will call attention to the fact in my discussion that that Fryer Hill apparatus, in allowing that drainage of the water does not permit the drainage of the heavy oil, and that answers the purpose of allowing the drainage of the water, and the mineral and oil is then carefully removed to settling barrels—and so on. After that we are not concerned with what becomes of it. But in carrying out of the operation, after these doors have been raised, constituting a floor just under the froth, and the water underneath that floor, then, by lowering this jar, it was possible to draw away everything but the froth, supported on that floor, because ^{after} the bringing together of the doors, everything else was drawn away.

Q. 208. The lowering of the jar would be just the same as the raising of the doors?

A. Yes. Of course we could, by changing the mechanism have drawn off everything above that floor, but it was very much more convenient to do it

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this way, and then the froth was left, and after that it was entirely possible to remove the froth entirely clear and by itself, as was done, and with the aid of a washing bottle, to wash it off into a bottle.

Q. 209. Explain to the court what your reasons are for saying that that is an aerated froth.

A. I am satisfied that after having read the Everson patent, with which I connect this publication, and with which Dr. Liebmann connects this publication, as in his opinion an experiment or an effort to carry out the Everson patent—after having read both of these and seeing the operation of it, I am satisfied that the rapid revolution, and Everson tells us there—
“In ^{floating} the concentrate after thorough agitation of ^{the} ~~float~~ ^{ing} the mass, and detachment of the sand—there are the two main points in the Everson patent. Now that operation is aided by these ^{force} and aided by the introduction, after the revolution starts, of acidulated steam, and the result of that agitation is the formation of this froth.

The words “and detachment of the sand” refer to the separation of the gangue. The gangue separates, settles, and ultimately is drawn off and of course that leaves the froth. This froth can only be an aerated froth because of the conditions of agitation, in my opinion, being rapidly agitated with the same kind of device that was used in a number of other illustrations.”

Q. 210. Has the quantity of ore anything to do with your conclusion regarding the character of the float?

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A. The character of the oil which, according to the wording of the Everson patent was 17 per cent, has no effect at all upon the question of whether a froth can or cannot be formed. A froth is readily formed with 17 per cent or a fraction of kerosene oil or a paraffin as described by Everson.

Q. 211. Would any other kind of flotation concentration be effected with 17 per cent of oil?

A. You cannot ~~a~~^effect the Elmore form of buoyancy flotation.

Q. 212. For what reason can you not ~~a~~^effect the Elmore form of buoyancy flotation?

A. In the first place the amount is absolutely inadequate to raise anything more than a very minute fraction of the mineral content; and the second place the agitation absolutely bars it. The agitation she describes absolutely bars the getting of the Elmore effect.

Q. 213. What authority have you for that statement?

A. It has been testified to by experts on both sides and particularly by Dr. Leibmann that the Elmore process is to be carried out with as little agitation as possible. I have myself carried it out with the greatest care and using different kinds of oil, the thick viscous oil, to carry out the Elmore process in a bottle, slowly revolving, and was able to get the Elmore effect with very slight evidence of the breaking up of the compact layer. With a thinner oil than the oil residum described by Everson you cannot get the same result.

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Q. 214. Did you ever compare the effect of agitation described in this Fryer Hill publication and the Elmore bulk oil process?

A. I have done it independently, following that test of the Everson process with a light hydro carbon of the kerosene type, and got a very excellent froth product with the kerosene; whereas, as altered by trying the Elmore method, I have failed to get a notable result.

Q. 215. Suppose the other conditions were corresponding to this Elmore process and you were to agitate violently with the same kind of oil, what would happen?

A. We would get a froth because we have gotten a froth with very heavy oils, the so-called fuel oils, the heavy oils have been used in a number of experiments.

Q. 216. You might just show the manipulation of that.

THE COURT: I think I remember that pretty well.

THE WITNESS: There is where the——

THE COURT: I think I remember that machine. I remember the experiments very well.

THE WITNESS: I have dwelt upon these experiments which seem to me to show the same—carry out the same principle. That is, the agitating mechanism which is driven with sufficient rapidity is certain in my mind to entrain air as well as to thoroughly admix and bring them all in contact with the sulphide particles, which is necessary if they put this hollow tube

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in the center prior to agitating—through that acidulated steam is injected.

Q. 217. Tell the court what that acidulated steam—why that acidulated steam was not used here and what was done instead?

THE COURT: Mr. Dosenbach explained that.

THE WITNESS: To connect these three things together, I connected the working of the Everson patent, I connect the description of the apparatus in the Fryer Hill publication and I connect what was undoubtedly perfectly available to the Criley and Everson publications, in which, while the apparatus is not described, we have the result described very minutely. A thick oil was used in this case and to water heated near to boiling was added enough sulphuric acid to give it a tartish taste. That gives us our acidulated hot water, corresponding to the acidulated steam, which follows immediately after in the Fryer Hill publication as well as in the Criley and Everson. In that case we have stated "enough sulphuric acid to give it a tartish taste". This acidulated water is then mixed with the mass of oil and ore. It does not refer to this question at all of its being injected in the hollow cylinder. "A thick scum of sulphate ^{urets} rise to the surface and ^{was} ~~is~~ skimmed off."

Q. 218. Doctor, now that you have been referring to this subject and the use of the word scum, I think it would be a good time for you to state your understanding of the word "scum" and how it has been used in these various patents in litigation?

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A. I have made a study of that because it seems to have some interest. I have made a search of the way in which the terms "froth" and "scum" are used in the various patents of the Minerals Separation, Limited, taken from the patent records. I have found nine English or American patents which I will enumerate and state how they used that term. To begin with the United States patent 835,120, which is the patent in suit, this patent uses the words "froth" or "scum" as synonymous in the specifications at four different places, sometimes saying "froth" or "scums" and sometimes "scum and froth". British patent, 7,803 of 1905, which corresponds to this foregoing United States patent, that is the patent in suit, also uses the expression "froth or scum" in four different places, taking them as synonymous terms. United States patent 835,143 of November 6th, 1906—that is the same date as the patent in suit—to Sulman, which is sometimes referred to as the boiling patent in which boiling water is used, uses the expression "froth or scum" to designate the result of the agitation and heat in two different places.

British patent 26,852 of 1908 to the Minerals Separation, Limited, sometimes spoken of as the aromatic hydroxy-compound patent uses the expression "coherent froth or scum" twice, and once the additional expression "froth or scum".

United States patent 962,678 of June 28th, 1910, which corresponds to British patent 2,359 of 1909 also uses the expression "froth or scum" and once the expression "coherent froth or scum".

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British patent 28,173 of 1908 to Sulman and Picard sometimes spoken of as the alcohol patent, uses the expression "coherent froth or scum" twice in the specification, and in three of the six claims they use the expression "froth or scum".

British patent 2,359, of 1909, to Greenway, Sulman & Higgins, known as the soluble frothing agent patent, uses the expression "froth or scum" three times and once also the expression "coherent froth or scum".

British patent 23,870 of 1910, to the Minerals Separation, Limited, and Nutter, uses the expression "froth of scum" three times in the specification and once in one of the claims.

United States patent 1,099,699 of 1914 to H. H. Greenway for aromatic hydroxy-compounds uses the expression "froth of scum" in the specification. That is the series of patents considering all of them as either taken out by or assigned to the Minerals Separation Limited, and it represents their use of these terms "froth" of "scum".

Q. 219. I have found one of these passages in the Hyde record, page 544 of the complainant's record in the Hyde case, Dr. Leibmann says: "The Fryer Hill publication of 1889 is clearly a further development of the Everson patent."

A. That is what I referred to.

Q. 220. Then he goes on in connection with that, coming to the Criley-Everson publication that the doctor just referred to and quoted, Dr. Leibmann

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says: "The Criley-Everson publication of 1890 is a modification of the Everson process as described in the Everson patent" and then goes on to discuss that, and I think anyone such as Dr. Leibmann and Dr. Sadtler, would see the earmarks are all there as to the relation of the two publications, both as to the time of the publication and the date of the operation and the kind of the operation."

MR. WILLIAMS: I can also give your honor one or two references on that topic. I suppose it is timely.

THE COURT: Yes.

MR. WILLIAMS: On page 388 of the same volume, volume 2, complainant's record, Dr. Leibmann says in answer to 8-Q: "The extract from the Daily Herald Democrat of October 30th, 1889, refers to a new method of treating dry silicious ores and an experiment of the concentration of such a dry silicious ore containing silver is described therein. There are several facts which induce me to believe that this extract refers to an experiment according to the previously discussed Everson invention, to which some new developments have been added. The extract states that the new method referred to and was suitable for the treatment of silicious ore. A similar statement is contained in Everson's specification. It is further stated that the ore treated was an ore containing silver and a concentration of the silver particles was obtained. Everson states that her process will probably only be valuable for the treatment of ores containing precious metals, such as gold, silver and copper. Ac-

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cording to the report, the ore is, after being crushed and while dry, mixed with oil, which again is in accordance with the Everson process disclosed in 348,157. The quantity of oil to procure thorough mixing of ore and oil must be somewhat similar to the quantity specified by Everson. The apparatus is new and apparently also the mode of agitation which is described." And then I do not wish to read further. And then there is a reference to the arastra-like fan, and the fact that the arastra is a slowly moving, grinding apparatus which is well known in mining. But I think there are some one or two further matters in defendant's record. There is a concluding statement which made it quite clear that this was just what you might call a resemblance in particles and nothing more. I can't put my hand on this just at this minute and I won't ask the court to stop for it. That was in another suit.

THE COURT: It is in the record you say?

MR. WILLIAMS: It is all in the record.

MR. SCOTT: Doctor, I think you may proceed with what you were discussing.

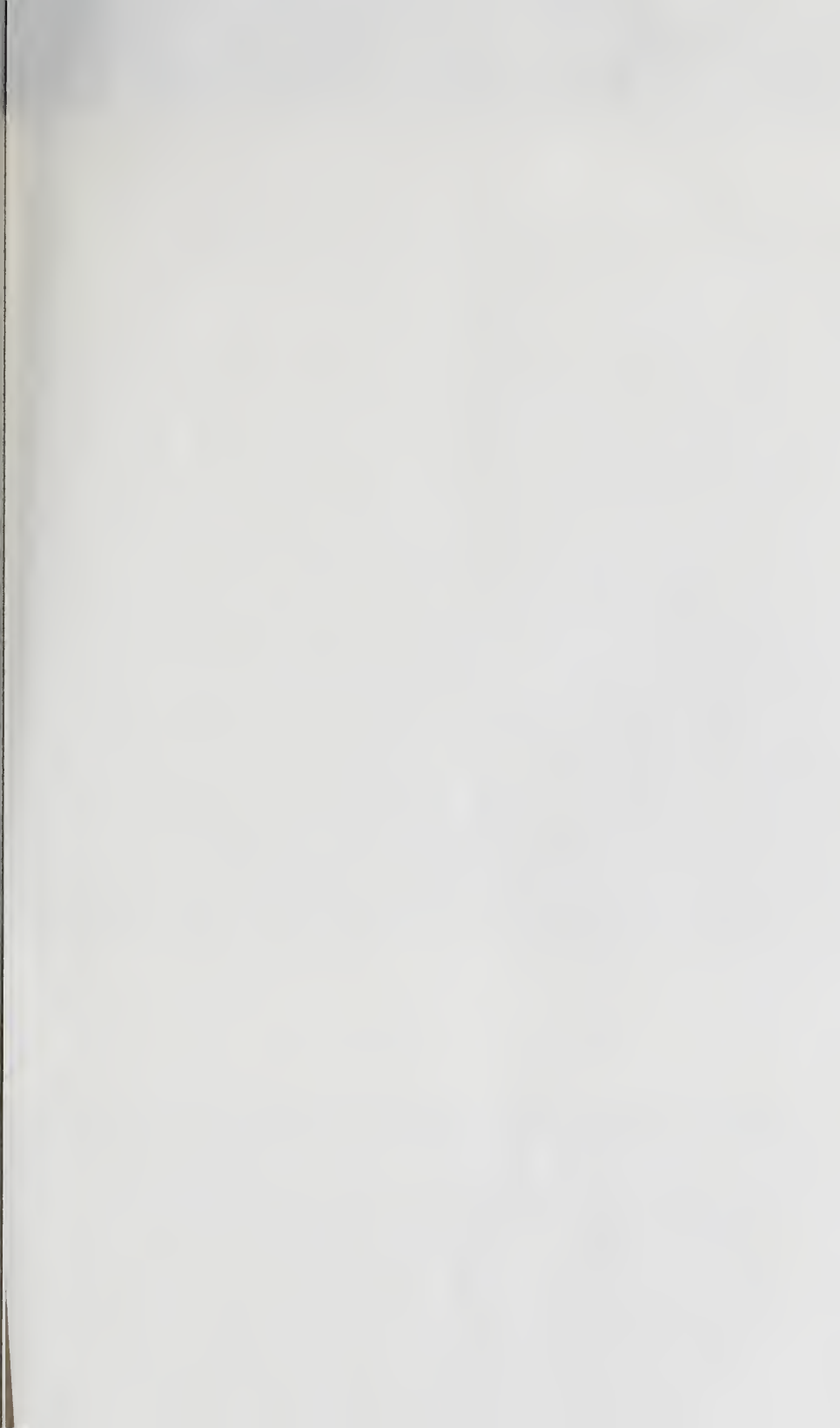
A. When court adjourned I was discussing the Kirby patent and had spoken of the first step and the second step of the Kirby patent and the fact that we could not consider the result, in the light of what would be accomplished by one of these taken separately, but Kirby intended them to be taken as a first and as a second step, the first step to be followed by the second; and he points out that the second step is

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a supplementary step. I proceed now to the quantity of oil used by Kirby. When we come to consider the Kirby patent, 809,959, when we come to consider it is the thin, distillable hydrocarbon oil indicated by Kirby as adapted to his purpose, we have several things to note. In the first place it is entirely insufficient to allow us to practice the Elmore buoyancy oil process which requires from 100 to 300 per cent of oil, reckoned upon the ore. Moreover, it is not the type of oil that is needed for the successful practice of the Elmore process, namely the viscous oil of the character of petroleum residum, of heavy gravity, and distinct viscosity. This thin, hydrocarbon oil of Kirby would not hold together without flouring—that is a breaking up of the contact layer into separate bubbles which no longer have the power of holding mineral particles by pure buoyancy flotation in the same way that the compact layer does—this thin oil would break up and develop flouring even under a very slight amount of motion used, if carried out by the Elmore method of operation. This I have experimentally verified in the experiment which I have carried out where it was tried in comparison with thick residual oil—I refer to the experiments which were spoken of a moment ago by Mr. Scott, which I carried out using a rather wide bottle in which was placed the ore, pulp and water, on which was a layer of heavy residual oil, and then by agitating that slowly—and the same thing was carried out by other witnesses in the trial at that time—by agitating that slowly we developed the El-

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more effect, that is the gathering together in the heavy oil residum layer of mineral particles, where they were held by reason of the flotation power, we will call it, or the buoyancy of this oil, the gravity of the oil being approximately .9 as compared with the gravity of water at 1. So, that there was a flotation power there of .1—that is one-tenth,—and supposing that we had equal volumes. In that way the Elmore effect was carried out and in the Elmore operation that was described in the California Journal of Technology it will be remembered that there was the slow screw working in such a way as to bring entirely in contact the thick viscous oil and the mineral particles contained in the pulp and thereby to cause the thick oil to take up those particles. That was a slow motion and was comparable with what was done in a small way experiment, in turning the bottle slowly through a number of revolutions. The same experiment, carried out with a thin, distillable hydrocarbon oil gives no result compared with the thick oil, because the thin oil in that turning process easily would develop the result called flouring and it is itself, because of its slight viscosity, incapable of holding its load without dropping very ^{readily} rapidly, so that it is notably inferior and has always been recognized in the practice as inferior to the thick residum oils which are particularly adapted to the Elmore process and, as was stated a moment ago, using the same amount of oil and the same mixture of flotation pulp and applying the rapid agitation method you get a result analogous to



P. 3668, L. 18, insert " in a small test experiment "
after (,)

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what is gotten in the square jar there with 25 per cent of kerosene; that is a permanent froth which remained heavily mineral-laden. Most important of all, however, in considering this question of the use of a thin hydrocarbon oil by Kirby in that account is the violent agitation of thin hydrocarbon and the ore pulp, in his first patent. That, of itself—that alone, that is the violent agitation alone takes this Kirby patent out of the bulk ore category and brings it into the aerated and agitation class. If you can eliminate the first step of Kirby and for a minute suppose the Kirby process carried out by this slow rotation of his form of apparatus with these arms, and the injection of air, you might have a combination of buoyancy flotation with a certain amount of ore particles raised by air bubbles, as has been described by other witnesses; but you cannot tear the Kirby patent in half and eliminate the first step, which is violent agitation. If you practice the first step, the results are such as make it impossible to have the Elmore result or the Elmore process.

The next point I desire to take up is: Will we get a satisfactory metallized froth with this thin distillable hydrocarbon of Kirby used in the amounts indicated by him? That this can be done with entirely satisfactory results was shown here in court twice, first in the experiment with the square jar with that milk-shake mixer used by Mr. Phillips, and of which the results are still there; and the other time by Mr. Dosenbach in the glass jar machine using a form of agitating ap-

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paratus very analogous to that shown by Kirby and obviously allowable under the Kirby patent, because as I said yesterday in testifying on this matter, the Kirby patent is a process patent illustrated by one form of apparatus but not tied up to that. And as I also said yesterday at the time of the Kirby patent application there were two very excellent agitating and aerating forms of apparatus known and particularly known in this art, the one being the Gabbett cone mixer and the other being the Johnson mixer, both of which were equally available in carrying out this, with the third form which is here referred to by Kirby. Now, the next question I take up is what was the nature of the froth produced by Kirby?

The froth produced by the carrying out of this first step of the Kirby process being the thin distillable hydrocarbon in the amounts as stated by him to be 25 to 75 per cent, the froth produced is an aerated froth, in which the air entrained by the rapid agitation with the form of apparatus illustrated by Kirby produces the air bubbles. The kerosene forms the material which holds up the oil films inclosing the air bubbles and in the presence of the air bubbles throughout the agitated mixture the metallic sulphides concentrate, in these oil films, stabilizes them and gives us therefore as a product a stable, mineral-coated air froth, which is the vital part of the aerated froth, mineral coated of the patent in suit.

This is the result, too whether we use the smaller or the greater amount of oil indicated by Kirby. I

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have personally carried out experiments in which I used 25 per cent of kerosene in practicing this first step of the Kirby process; I have used 75 per cent kerosene in the same form of apparatus and have obtained excellent, stable mineral froths, in both cases. They are thicker when using the larger amount of oil with sufficient agitation. The only difference in the result using from 25 to 75 per cent was a more copious mineral coated froth where the larger amount of oil was used. I, in fact, have carried out experiments using 5 per cent and running up to 75 per cent of kerosene.

I now would like to take up for a moment and discuss a dissenting opinion on this matter. I have expressed myself just now as to what I considered was the character of froth produced in the Kirby process, that it was an aerated froth and described it. I now desire to turn to the opinion of Dr. Leibmann on that matter as given on page 437 of volume 2 of the Hyde original record, complainant's record.

Q. 221. Complainant's record?

A. Complainant's record, page 437. Dr. Leibmann there says: "Kirby's process consists in the separation of minerals from ores: (a) partly by buoyancy flotation; (b) partly by lifting the aggregates of mineral in oil, which are at the bottom, by air bubbles to the top, and removing the products of (a) and (b) together." I do not agree with Dr. Leibmann in this matter. I believe that this statement of his would make the first step—he puts it in two parts, a and b

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—this would make the first step of the Kirby process, using a thin distillable, hydrocarbon and violent agitation as described in the section (c) in the specification to have as its result buoyancy flotation. Now, I have shown, in discussing this matter a moment ago that that is absolutely fatal to any Elmore result, and we cannot get buoyancy oil flotation if we practice honestly and as described in the patent the first step of the Kirby process. The operation of the second step, of slow agitation, is described by him as producing the lifting of mineral in oil, to air bubbles—of air bubbles, to the point—

Q. 222. As described by Dr. Leibmann, not Kirby?

A. As described by Dr. Liebmann as having the result which is mentioned in his statement of the second part of the result. That is a supplementary process and probably has that general result there stated. There was a slow additional raising of mineral particles, and undoubtedly by the aid of the injection of air and the currents produced thereby, which supplements the original result of the violent agitation.

Now, a few pages further on, in the same record, on page 442, in the continuation of Dr. Liebmann's testimony, near the middle of the page, Dr. Liebmann says: "The experience which I have gained from experiments makes me doubt whether the assertion made under No. 3, viz., the possibility of the use of a thin hydro-carbon for the purpose of the recovery of the minerals is a fact. In ~~any~~^{my} view of it, no thin oil can be used ~~to any~~^{with} advantage, and the patentee

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himself describes that the mineral collected at the bottom of the layer of thin oil, which is near the water surface." Dr. Liebmann has here said that in his view and in the light of his experience no thin oil can be used, which I think simply states the weight of Dr. Liebmann's further experience, because I take now his second view rather than his first view—and that is in the same line with mine, that you can not use thin oil to advantage in trying to practice buoyancy oil flotation, and he doubts, therefore, whether the thing is practical. I doubt whether it is practical, but I see the point of the use of thin oil by Kirby if we practice the Kirby process in its entirety. Dr. Liebmann has well stated the difficulties of using a thin hydro-carbon oil for buoyancy flotation, and if we add to this statement the fact that from 25 to 75 per cent. of this thin hydro-carbon oil is recommended by Kirby instead of 100 to 300 per cent agreed upon as needed for the Elmore buoyancy flotation, and if we add to this again as an additional element the violent agitation that Kirby advised, I see how impossible it would be to obtain any buoyancy flotation results in connection with the first step of the Kirby process, or as a summary—as a result of the combined steps.

I now pass next, in considering the Kirby patent, to the conditions of the removal of the froth, as stated on page 3, lines 37 to 41 in the Kirby patent. "The rotating movement of which—" And now we have passed the practice of the first and second steps, one

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following the other—"the rotating movement of which leads the floating scum of hydrocarbon liquid, air bubbles and concentrates, against the curved skimming bar, which is hung so as to assist and divert this floating layer and cause it to pass into the settling or washing chamber, box No. 29." We have here described a device characteristic of this Kirby patent, which is the exact equivalent of the skinning device which is in daily mill practice; that is, the froth is moved along from the surface of the spitzkasten by the continued motion of a slowly moving bar, which hangs just low enough to move the froth easily, without cutting down below the line of junction of the froth and the water, so that it really moves the froth by taking off the top of it, and the larger body of it, and in that way continually discharges into the launder. That is the case, with the skimming bar here, the movement of this accumulating froth or floating scum, it is called here, and that is just as strong a term as was used in the Minerals Separation patent; the floating scum of highly mineralized ore bubbles and concentrates into the washing chamber.

Now, we have next on page 4 of this patent the saving of the froth after movement by skimming, lines 12 to 17: "The stream of skimming enters the central cylinder, within which the water and the hydrocarbon separate^a, the former sinking while the latter, with the accompanying concentrates and air bubbles, floats in a layer as shown." The stream of skimming—Skimming is a very inexpressive word, but re-

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fers to what has been taken off by the skimming bar—The stream of skimming goes on, and the water sinks, while the latter, meaning the hydro-carbon with its accompanying concentrates and air bubbles, floats in a layer as shown. There is a clear indication here that we have the same form of combination of concentrates and air bubbles in an aerated froth that was skimmed off, and I consider it to have been the result of the practice of the first and second Kirby steps, one following the other.

We go now to line 17: "The ^{stirring} apparatus, No. 42, has its arms revolving gently within this layer, so as to ~~bring~~ ^{pick} up and discharge air bubbles and assist the separation." If we have a compact layer of oil, with only incidentally a few air bubbles on it, this step would be entirely needless; it would have no meaning to it; but it has a meaning as read here. The arms revolving gently within this layer, break up and discharge air bubbles and assist the operation. We have seen in an experiment here the way in which slow rotation can discharge air from an aerated froth; in other words we can get the air out of the froth by slow rotation.

Then again we turn on this same page, further down, to line 31: "The concentrat^{ion}~~ion~~ which falls to the bottom of the tank, accompanied by the hydro-carbon which adheres to them, are drawn off in a thick condition." That means that the froth and concentrates are drawn off in a thick condition, along with the hydro-carbon adhering to them, through the pipe

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No. 45. These descriptions follow clear through to the end of the description of the Kirby process and seem to me assurance that the practice of the first and second steps leaves him to deal with an aerated froth carrying mineral material. The action of the skimming bar and the after treatment referred to here of the concentrate and air bubble mixture are all in accord with that idea. They are not in accord with the idea that we would have here a compact layer of oil carrying in it mineral particles held up by buoyancy flotation, and not connected with froth formation.

I also would like to call attention, before finishing this matter, to claim No. 1 of the Kirby patent. In claim No. 1 of the Kirby patent we have in line 14: "First, violently agitating the mass so as to break up said distillable substance"—meaning the thin hydro-carbon liquid—"into minute globules." Kirby does not say that air is entrained, but I do not see that we can escape that conclusion, if we remember the Kirby form of apparatus and the words "violent agitation." The next following in this claim, "in allowing said mass to settle." That is a step—"whereby a considerable quantity of mineral particles, having become coated with said substance, will float to the top of the mass." Now, that ends the first step, the production of the aerated froth by agitation, the allowing it to come to rest, the separating and rising of the froth as described here, which has become coated—"the mineral particles having become coated with

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said substance," meaning the hydro-carbon, will float by reason of the air bubbles to the top of the mass. "And in gently agitating the portion thereof which settles." That gentle agitation is to stir up the portion on the bottom, which is a counterpart of the re-treatment of the tailings, in which a certain amount has dropped, and the ^hflowing into the same of a gas for the purpose there stated, of assisting the flotation of said substance; that which is on the bottom—and the mineral particles coated therewith. And then, finally, removing the floating layer.

I would just say, finally, in connection with this Kirby matter, that in my opinion the Kirby process, using from 25 to 75 per cent of a light oil for the production of a mineralized froth, accords entirely with the theory of froth production as I understand it, and as it has been testified to in this trial. The thin hydro-carbon or kerosene, which we will take as an illustration of that, is not of itself one of the class of the particularly frothing oils; it is not one of the class that is so characterized, because of its practical insolubility in water, and its inability to sufficiently increase the viscosity of the air bubble film of and by itself. But, when you add the ore pulp and produce violent agitation in contact with the thin ore pulp, you get a permanent froth, because the sulphide mineral concentrating in the oil film gives the needed viscosity to the film, and the result is a permanent mineralized froth. The kerosene, whether used ^{as} 25% _{of}

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or 75%, contributes the oil film with some concentration in the film, which, when stabilized by the mineral particles, gives us a stable froth in every case, no matter what the proportion of the oil is.

Q. 223. You observed the experiment performed by Mr. Dosenbach, representative of the Kirby patent, did you not?

A. I did.

Q. 224. I presume you can not carry the details all in mind, therefore I refer you to Mr. Dosenbach's description. Part of the description appears on page 1224, extending a little onto 1225, and the rest of it appears on page 1227 of the typewritten transcript. I wish you would just examine the details of that experiment, and state whether that represents what he did, and how it accords with your view of the Kirby Process.

A. I have refreshed my memory by reading the description. I saw the operation carried out, and recall the results. In this case 25% of kerosene distillate was used, which represents the thin distillable hydrocarbon that the Kirby patent speaks of. It was carried out in a glass jar with the rotating mechanism, which in my opinion is the counterpart, the equivalent of the apparatus figured in the Kirby patent. Kirby prescribes violent agitation; it is mentioned in three of his claims in those words, and in the specifications he speaks of thoroughly agitating for the purpose of effecting thorough admixture. I therefore believe that

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we had a perfectly fair practice of that Kirby first step in using that apparatus which was used here in the experiment. The amount of oil was taken as stated by him, the character of the oil was that stated by him and the operation was carried out to the end of that first step, with a view of seeing what result was obtained in that first step. The whole of the Kirby machine was not set up, and the practice of the secondary step of trying to recover more of the mineral from the gangue in which it was inclosed and from which it had not been originally raised in the froth—That was not practiced because it did not throw any light at all upon the single question at issue, as to whether a froth is produced in the Kirby process, and if so, what is the character of that froth. I saw the operation carried out, and I recognized, as stated here, the result: "A copious, highly mineralized froth is formed."

Q. 225. The patent in suit refers to the two Cattermole patents. Will you state your understanding of the Cattermole patent No. 777273, and the relation between that process and the process of the patent in suit.

MR. WILLIAMS: Page 714 of the Hyde record.

A. I have before me the patent No. 777273, to Arthur Edward Cattermole. In this Cattermole patent we have the following statement, beginning line 16 on page 1: "The invention depends upon the application of the following facts: First, ^{when} ~~by~~ a mixture of

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powdered metalliferous matter and gangue is treated with oil suspended in water, that is to say ^{in an emulsion} the oil has a more or less selective action, and will coat the particles of metalliferous matter in preference to the particles of gangue, while the particles of gangue will be wetted by the water." That statement of fact was quite well known, and had been disclosed originally by Haynes, and afterwards referred to by Everson, and is also disclosed by Froment; that is this selective action of the oil for the metalliferous particles and the coating of the metalliferous particles in preference to the particles of gangue. That is all that has to be considered for the moment.

Now, the second statement of facts on which the invention depends is as follows: "If the water which is mixed with the oil is acidulated, with mineral, fatty, or other acid, the selective action of the oil will thereby be rendered more marked and ^{clear} ~~decided~~." That was stated very clearly in the Everson patent, and Dr. Liebmann has testified that Everson contributed the feature to the art, that acid aided in the selective action of the oil.

The third statement of fact is as follows: "If the proportion of oil is kept within reasonably low limits, (^{differing} ~~varies~~ in different cases according to the nature of the mineral to be treated and the consistency and nature of the oil,) and if the mixture of water, oil, metalliferous particles and gangue be thoroughly agitated, the metalliferous particles that have become

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coated with oil will adhere together and form granules, which granules, partly by reason of gravity ~~and~~ partly on account of their bulk as compared with the individual grains of gangue, will offer ~~large~~^{ready} means ~~for~~ separation in an up-current separator, a jig or other similar appliance." This statement of fact, if considered broadly and with reference solely to the proportion of oil, is not a correct statement, because I have seen in the course of this trial the production of an excellent mineralized froth by the carrying out of agitation in the form of apparatus as shown here, with the Gabbet cone mixer, using a relatively larger amount of oil, which has been considered as the Cattermole proportion, or within the Cattermole limit. That granules can be formed, of course, is true, but I do not consider that the formation of the Cattermole granules is dependent solely or even mainly upon the statement of the proportion of oil, that the proportion of oil is to be kept within certain limits. The experiment which was carried out by Mr. Dosenbach and which was witnessed by me, showed plainly that the production of the Cattermole granules was dependent upon certain conditions of operation, and not upon agitation in the presence of a certain particular amount of oil. The first result in the carrying out of the experiment was an excellent froth. That was obtained under the conditions of rapid agitation with the Gabbett cone mixer, using baffles in the cylinder. Without removing the baffles it was found possible

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to break down this froth, discharge the air from it and produce the aggregation of the mineral particles spoken of as granules, in the same vessel with the same mixture, solely by changing the condition of agitation. Therefore I do not consider that this third statement of fact is true in the way in which it is stated, and I do not consider that this attributing the formation of the granules to the proportion of oil alone is an accurate statement.

The statement is made further on that this action, meaning the production of the granules under the conditions stated here, is facilitated if the oil, before the addition to the liquid, is brought into a condition of emulsion in water containing a small amount of soap or other emulsifying agent. That, of course, is very likely, but that is simply a facilitating of the action; that does not involve modifying the statements that I have made, that the production of granules is not dependent upon the conditions stated in lines 29 and 30 of this patent.

Q. 226. Can you explain that apparatus which is shown in the Wolf patent No. 787814, and what its bearing is upon your discussion of these different processes?

A. The Wolfe patent, No. 787814—

MR. WILLIAMS: Complainant's record Volume 3, page 966.

THE WITNESS: The Wolfe patent, dated April 18th, 1905, has some considerable interest, because

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it shows clearly an efficient aerating mechanism—an agitating and aerating mechanism for the mixture of oil and a thin air pulp in connection with a spitzkasten, and the obvious intent and plan, as described in the patent also, is the production of a froth in the first vessel shown, and the drawing off of that froth through a short launder or connecting tube at once from the top of the water in the spitzkasten, where it flows, as stated; while, on the other hand, the gangue sinks and is drawn off from the bottom of the spitzkasten, and the flow is further carried then through a side connection from the upper level in the spitzkasten. This connection of the froth producing mechanism and the spitzkasten is interesting as shown at this day. I refer in the patent to the description on page 1, beginning line 61: "The mixture of oil and pulp passes into the hollow cylinder B¹ and the rotation of the turbine wheel, B², causes a rapid circulation of the mixture ~~downward~~ ^{downward} within the cylinder, and upward between the cylinder and the vessel B." Stopping there for a moment I wish to recall that I have already stated in connection with this construction, when I referred before to the Wolfe patent, that Mr. Sulman had stated in his testimony in this record that this was a very efficient apparatus for producing aeration results, because of the construction of that hollow cylinder, which caused it to act as a baffle, and he considered it to be a very efficient baffle for the purpose of preventing continuous rotation within the circular walls of the cylinder.

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In line 66, page 1, we have the further statement: "The liquid is continuously discharged from the mixer through the pipe B5, and passes into the separating tank or spitzkasten, and here the sulpho-chlorinated oil adhering to the mineral of the ore, floats, ^{while} ~~and~~ the gangue ~~is~~ the water sinks and is removed by the waste pipe C1." I also find further down on page 1, line 92, the following statement: "By the means thus provided for eliminating the gangue it is possible to treat ores with such a degree of agitation that ~~the~~ ^{the} whole of the mineral contents are taken up by the oil, accompanied, however, by a ~~very~~ ^{not} inconsiderable portion of ~~the~~ gangue." That is a result which happens in practice constantly and involved retreatment and repeated retreatment to get out of the first tailing the valuable mineral which was not floated in the primary cell.

Wolfe, in this patent, believes that he can remove the gangue which is there by a hot water treatment. We are not particularly concerned with that, because it is not a matter which in my view has any bearing upon the patent in suit; but I only refer to this Wolfe patent for the purpose of calling attention to the action of the apparatus and the type of the apparatus, as an efficient agitating aerating device combined directly with a spitzkasten, and for a purpose which is indicated very satisfactorily when we come to the claim.

I would call attention to claims 3, 4, 5 and 6 of

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this Wolfe patent, in which we have the reference to agitation and the reference to separation of the mineral-bearing oil from the pulp, and flotation. The word flotation appears there as the separation method; that appears in four of the claims "Separating the mineral-bearing oil from the pulp by flotation." After having effected a vigorous agitation with an efficient form of aeration^{ing} apparatus.

Now, I feel satisfied that we can not practice this procedure of first practising agitation with that form of apparatus, without producing an aerated froth, which holds the mineral, as stated, quite completely, and then if we follow that by a flotation as described here in these claims of the mineral-bearing oil, an air bubble mixture over the top of the spitzkasten, that it is impossible to have anything else than the removal of a mineral-bearing froth.

Q. 227. Doctor, you called attention the other day to the fact that in Froment's Italian patent the expression used in the complete specification of the British patent, that the invention is a modification of what is known as the oil process of ore concentration, was not used—that this expression was not in the Italian patent. Will you tell whether this expression is in the provisional specification of the British patent, and state also, if you have information, what the relation of the provisional specification is to a complete specification.

A. On looking at these patents I find that there

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is no word at all in the Italian patent, either in the French or the English translation given here, of that matter, of its having any relation to a previously known oil process. When we turn to the English patent, we find the provisional specification, which was the more immediate contribution of the inventor, I imagine, or, as I understand it, to the patent agent, contains no reference to this connection or supposed connection. The statement in the British patent that it is in any way related to a previous process, only appears finally when we come to the complete specification, which stands in the name of Henry Harris Lake, the patent solicitor, and that is as follows: "This invention has reference to the concentration of metal-liferous ores and earths for the purpose of separating and recovering therefrom the finely divided metal or metallic compounds, and consists of a modification of what is known as the oil process of ore concentration." That was a gratuitous addition made finally in the complete specification in the English patent. It does not appear anywhere in the Italian patent, and appears only in this last statement in the English patent, and it has not justification, to my mind, from anything that is found in the patent, English or Italian.

MR. SCOTT: I offer the British patent referred to, No. 10929, of 1910, to Theodore Jesse Hoover and Minerals Separation Ltd., this being the patent to which Dr. Sadtler referred as containing a statement that the Froment process produced a froth.

THE COURT: That is not in the Hyde record?

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MR. SCOTT: No, sir; it is an additional one.

MR. WILLIAMS: In view of the fact that it was in the Miami record and I know all about it, I have no objection.

Patent No. 10929 admitted in evidence without objection, marked DEFENDANT'S EXHIBIT No. 216.

MR. SCOTT: I offer a drawing illustrating a picture of the Fryer Hill machine which was admitted in evidence as one of defendant's exhibits.

Drawing admitted in evidence and marked DEFENDANT'S EXHIBIT 217.

MR. SCOTT: You may cross examine.

CROSS EXAMINATION,
BY MR. WILLIAMS:

I would call your attention, Mr. Scott, to the fact that the witness referred to a number of patents in his testimony, ~~and was~~—and one of them was patent 962,678.

MR. SCOTT: I will offer that to make the record complete. I offer patent 962,678 of Sulman, Greenway and Higgins.

Patent admitted in evidence and marked DEFENDANT'S EXHIBIT 218.

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MR. WILLIAMS:

X-Q. 228. Did you testify as follows in the suit of Minerals Separation, Limited, against Miami Copper Company, relative to the Fryer Hill publication:

"X-Q. 667. Then you got your thorough agitation out of the Everson patent?

"A. I took that from the Everson patent.

"X-Q. 668. There is not anything here which defines the nature of agitation to your mind?

"A. The only statement I find here is: "Arastra-like fans, attached to the bottom of the tube, keep the whole mixture in motion." That is a very vague statement, and it is not at all as definite as the statement in the patent.

"X-Q. 669. Well, now, this Fryer Hill publication contains no directions as to the quantity or proportion of oil to be used—is that right?

"A. That is right. Those have been taken from the patent.

"X-Q. 670. It contains no directions as to the kind of agitation to be used—speed of agitation?

"A. No, it does not.

"X-Q. 671. And is not associated with any directions representing any definite mechanical structure?

"A. There are none.

"X-Q. 672. It contains repeated statements about mineral laden oil, mineral charged oil; that is right, is it not?

"A. There are several statements.

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"X-Q. 673. And yet you will take this article as the basis of a representation in this court that this machine, operating at about 2,000 revolutions per minute, is the machine there described, and that the operation produced ~~is~~ that machine is the operation there described—is that the situation?

"A. I have explained in previous answers that from the dates of this publication, and the publication immediately following it, in which latter publication reference is made by name to the Everson process, and then the fact that the general, very vague outline of this newspaper article is entirely compatible or in accord with what could be done. Following more accurately the directions of the patent, I have been led to consider that it is a description of the experiments carried out in the way of developing the Everson patent." Did you so testify?

A. I think probably you have read that correctly.

MR. SCOTT: Do you wish to compare it, doctor? If you do, you may compare it with this testimony that has been read to you.

MR. WILLIAMS: I have read it with the greatest care. I would like to know whether I have read it correctly.

A. You marked the beginning and the end of it?

X-Q. 229. Yes.

A. And the ending of it is here?

X-Q. 230. Down here.

THE COURT: The better way then would be for the witness to have a copy and follow it.

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MR. WILLIAMS: I am sorry that the time should have been wasted. The witness has a copy of it. I thought he had it right here and I wasn't paying particular attention.

THE COURT: Oh, I think he can say that you read it correctly. He will have the privilege of checking it up.

THE WITNESS: I think I answered correctly those questions at that time. I think the answers as stated by you were the answers given at that time.

MR. WILLIAMS: I want the witness to answer the question that I have read it correctly with the understanding that he may correct my reading if I have made any mistake.

A. I believe it has been correctly read.

MR. WILLIAMS: I will read it over again and you will follow me.

MR. SCOTT: The doctor admits you read it correctly, Mr. Williams.

MR. WILLIAMS: Page 1081, volume 2, Miami record.

(Whereupon counsel read the extract from the witness' testimony in the Miami case as previously quoted.)

Have I read that correctly?

A. You have. Mr. Williams, do you wish me to say whether I agree with the statement of the view I there expressed?

MR. WILLIAMS: I don't care for that now.

A. All right.

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X-Q. 231. Now, turn to page 1083 of that volume commencing at question 687. I will read the following, and ask you to follow it:

"X-Q. 687. Now, you have referred to the Criley and Everson publication, appearing on page 393 (Ex. Book, p. 17). Now, in that we have the distinct statement that the oil used was a black thick oil? You know that, do you not?

"A. I do.

"X-Q. 688. You have not carried that out, have you?

"A. I have not.

"X-Q. 689. You were asked to consider this publication in question, and you appeared to pay no particular attention to it in your answer. Do you regard, as a disclosure of a metallurgical operation, capable of being carried out, what is there disclosed?

"A. It does not, as a disclosure, give enough details to make it possible to carry it out in a definite and accurate way. It leaves entirely too much to chance.

"X-Q. 690. Will you accept what the Privy Counsel said about the Criley and Everson publication? (Ex. Book, p. 209?) Even if the test process is not to be discarded as a failure, it does no more than give information "that if to a greased mixture of pulverized metal and rock you add boiling sulphuric acid in a sufficient quantity of water in some way a differentiation is effected as between the metal and the gangue." That is quite as complete a statement as is given in this publication. It is a very fragmentary statement.

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Will you accept that as a proper description of the extent of the disclosure?

"A. No; I would not accept it for that reason.

"X-Q. 691. You will not agree with the Privy Council?

"A. No."

Have I correctly read your testimony in the Miami case?

A. You have, yes.

X-Q. 232. Are you familiar with the definition of an *arastra*?

A. I have heard it fully explained and it is in the illustration.

X-Q. 233. Have you seen the illustration in the Century Dictionary?

A. Yes.

X-Q. 234. Representing a vertical arrangement with stones, dragged around by a team of mules, traveling around and dragging it?

A. Yes.

WHEREUPON an adjournment was taken until 2:00 o'clock P. M.

2 o'clock p. m., May 3d, 1917.

X-Q. 235. Relative to the references that you have made to Ure's Dictionary of Arts, Manufactures and Mines, the first of these references was to an illustration on page 332, described on pages 331 and 332. The apparatus is shown in Fig. 1379, and was given by you as an example of a *spitzkasten*, was it not?

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A. Yes, as a separating vessel.

X-Q. 236. And I understand that you said it was a classifier?

A. I don't recall whether I used that expression or not.

X-Q. 237. The description of this appliance says that it is a separating box, which receives slime water, and that the heaviest portion is discharged at the bottom and goes to the buddles or shaking tables. That is correct, is it not?

A. That is so stated.

X-Q. 238. Do you know what a classifier is in ore concentration?

A. I don't know in any accurate way; I only know that the principle is that of allowing the heavier particles to separate, and the lighter ones to pass on and pass relatively successively in the order of their gravity.

X-Q. 239. And as a matter of fact, in a classifier it is the order of the sinking power in water rather than gravity which controls, is it not?

A. The sinking power of the materials in water, yes.

X-Q. 240. Now, the illustration on page 335, this is also a slime separator, is it not?

A. It is spoken of as a form separator, in which the compartments shown, numbers 1, 2, 3 and 4, are to serve for the purpose of receiving minerals of different densities and size, and they deposit successively according to their density as carried along by the

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stream of water. That would be, I presume, a classifier, although I do not use the term in any technical sense.

X-Q. 241. On pages 356 and 357 the apparatus shown in Fig. 1419 is described as a dolly tub, or packing kieve. Do you know what that means?

A. Well, I read the description, and I understand what is to be accomplished in this particular use here described of this apparatus. I did not intend to cite the apparatus as one which would be used for that purpose, but as a form of apparatus which, removing that detachable lid, was perfectly adapted for serving as an agitation vessel which would necessarily, if rapidly rotated, entrain air. It was offered for that purpose, for illustration.

X-Q. 242. And in the description it says that as the handle is turned by two men, slime is shoveled into the top. You knew that, did you not?

A. I read the description as given here. It is illustrated as operated by hand power, and a couple of men are spoken of as taking hold of the handle and turning it rapidly. It is very obvious to me that it is just as capable of being rotated more rapidly by a power connection with the aid of a pulley. It does not affect the purpose for which I introduced it, which was to call attention to the form of agitation which would be accomplished by these paddles.

X-Q. 243. Figure 1420 shows the condition at the completion of the operation with the various strata of solid material as they separate, does it not?

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A. It does.

X-Q. 244. Referring now to the translation of the work of Agricola I read from the test the description of the apparatus which is shown in the photograph, defendant's exhibit 51. I read this description as follows: "Quicksilver is placed in each tub, across which is fixed a small plank, and through a hole in the middle of each plank there passes a small upright axle, which is enlarged above the plate to prevent it dropping into the tub lower than it should. At the lower end of the axle, three sets of paddles intersect, each made from two little boards fixed to the axle opposite each other. The upper end of this axle has a pinion held by a bearing set in a beam, and around each of these axles is a small drum made of rundles, each of which is turned by a small tooth drum on a horizontal axle, one end of which is mortised into the large horizontal axle, and the other end is held in a flat cup with thick iron plates in a beam. Thus the paddles, of which there are three sets in each tub, turn round and agitate the powder, thoroughly mixed with water and separate the minute particles of gold from it and these are attracted by the quicksilver and purified. The water carries away the waste." Have I read that description properly?

A. You read it accurately, yes, sir.

X-Q. 245. Relative to the first method disclosed in the Everson patent, you testified in the Miami suit as follows, did you not, page 1059, X-Q. 502, "It did not seem promising from a metallurgical standpoint as an

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operation? A. No, sir. X-Q. 503. And you have not done it? A. No, sir." You so testified, did you not?

A. I did so testify in regard to the first illustration of the Everson patent.

X-Q. 246. Referring now to your testimony in the Miami suit, page 1067, where you were asked on X-Q. 553 what devices and methods were well known in the art in the wet separation of ores in 1886 you answered: "A. The spitzkasten, or its equivalent, was known and available in that case, or if not by name, its equivalent in the form of some overflow vessel. X-Q. 554. Was there not another device used in the wet separation of ores which was peculiarly adapted for washing out by a complete overflow, to-wit, the water classification apparatus? A. I explained in my testimony yesterday that I was not a metallurgical engineer, and therefore I must decline to say what was known at that time, of wet concentration methods, because I have not studied that." Did you so testify in the Miami case?

A. I did so testify at that time.

X-Q. 247. Referring again to your testimony in the Miami case, page 1056, relative to what you had done in that case as to the carrying out of the Everson patent and the Fryer Hill publication, did you not testify as follows: "X-Q. 477. What you have done, as I understand, is to take the proportions of oil which are described in the patent, and you have done things with them? A. Yes, sir." So far as I have read that is accurate is it not?

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A. That is correct.

X-Q. 248. I did not add the final part of the answer because I did not think it adds to the explanation. Now, relative to the description of Froment as a froth which you say you found in certain British patents and particularly British patent No. 23,870 of 1910, I refer you to that patent which is at page 1005—commencing at 1001.

A. The British or the Italian?

X-Q. 249. No, the Minerals Separation, Limited, and Nutter patent 23,870 of 1910. That appears in the Hyde record, complainant's record, volume 3, page 1001. I first refer you to page 1003 which is page 3 of the specification at the commencement of the complete specifications. In the last paragraph there is a general reference, is there not, to processes described in previous patent^s, including the British patent corresponding to the patent in suit and the British patent corresponding to the solution patent?

A. If you can give me the page and line of the patent I can find it.

X-Q. 250. The last paragraph of page 3 of the specifications, page 1003 of the record. And this statement does not include the Froment patent, is that correct?

A. The statement at that point does not include it but in that same complete specification it is included at the point at which I quoted, in the same complete specification.

X-Q. 251. I didn't ask you that.

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A. It is not included at this point.

X-Q. 252. Now, the point to which you call attention was on page 5 of the specifications as I recall it?

A. Yes.

X-Q. 253. Line 22 to 24, is that right?

A. That is right.

X-Q. 254. And the patent states: "The process employed to obtain these froths or scums may be any of the well known flotation processes as described for example in patent No. 12778, 1902; 29374 of 1904, 7803 of 1905, and two others and this 2359 of 1909.

A. That is what I quoted.

THE COURT: Now, I want to understand this clearly. This speaks of producing froth and scum, and then says it may be any of the well known flotation processes, and names amongst others, the Froment patent; is that right?

MR. WILLIAMS: Yes, sir, having become well known by reason of the fact that it was patented, and that the patent was widely published.

X-Q. 255. Now, I call your attention to the fact that on page 3 of the patent wherein the Froment patent is omitted, the reference is to processes—"that have hitherto been used in the practice of the separation of metallic sulphides from gangue." That is true, isn't it?

Let me read that. It is true that the processes which are there enumerated are spoken of as hitherto used for that specific purpose, of separating metallic sulphides from gangue, and they proceed then to par-

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ticularize as to their new application of the flotation processes, a separation between metallic sulphides, which was the point of the invention, and for that reason they quoted these prior patents.

X-Q. 256. Now, let us turn to the California Journal of Technology, commencing on page 681, exhibit 47. The first part of this article, up to the point where a reference is made to the foam effect, is devoted entirely to the Elmore oil buoyancy flotation process, is it not?

A. Down to the heading "Laboratory Methods." That part which precedes that is devoted to the account of the Elmore process, and particularly with reference to the question of the supposed further development of it by means of a centrifugal separator. That carries us down to the heading "Laboratory Methods."

X-Q. 257. Now, in the part of the description preceding that heading, and the particular description of the Elmore commercial apparatus illustrated on the first page of the article—that is the Elmore commercial apparatus is it not?

A. I presume it is. It is referred to there as a plant designed by the Oil Concentration Syndicate. I don't know anything at all about the connection that that particular syndicate may have with the Elmore process, but it is undoubtedly referring to the Elmore process.

X-Q. 258. Don't you recognize that as substantially the apparatus that is shown in the Elmore first patent?

A. I can not be quite certain about that, but I am willing to say that it carries out the Elmore procedure in accordance with the spirit of the Elmore process.

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X-Q. 259. I now show you the drawing of the Elmore patent, the first process patent, No. 676679, and ask you whether or not the drawing in this California Journal does not show in substance the same apparatus.

A. It shows the same general plan of operating.

X-Q. 260. In reading over this description I find the following: "The mineral laden oil, collected from the separators, is carried to a large receiving tank, B. Here, after being heated, in order to thin it and to overcome its viscosity, the oil is charged into centrifugal machines, where the concentrates are separated out. The oil, free from its load of mineral, is pumped back to the original storage tank to be used again." That is correct, is it not?

A. That is correct.

X-Q. 261. The expression "mineral laden oil" is an apt expression to describe the Elmore float?

A. That is the expression which refers to the way in which the mineral is carried in the Elmore heavy residuum oil.

X-Q. 262. And in the Elmore process heat is not used in the process because it impairs the viscosity of the oil, is that true?

A. Not up to this stage.

X-Q. 263. Not until the separation is completed?

A. Until the mineral has gone into the oil.

X-Q. 264. The mineral has gone into the oil and the float has been overflowed, and after the float has gone into the receiving tank.

A. I don't know anything about the float; I don't

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know just how you apply that term in that case, but following the illustration here, the separation of the compact oil layer from the water has taken place, and the mineral is carried in that upper oil layer.

X-Q. 265. And then this description says that the mineral laden oil goes into the receiving tank B, and there heat is applied, does it not?

A. After that, in order to advantageously centrifugate.

X-Q. 266. And also to overcome the viscosity of the oil, that is the language?

A. That is the purpose, yes.

X-Q. 267. And in the process up to the point of the separation, heat must be avoided, must it not?

A. In the Elmore process.

X-Q. 268. Then this description speaks of the oil as a heavy residuum, does it not?

A. It does.

X-Q. 269. And says usually about a ton of oil is kept in operation for each ton of ore, does it not?

A. Yes, usually about one ton of oil.

X-Q. 270. And then it speaks of an advantageous method of separation, whereby "the losses are not greater than from one to three gallons of oil per ton of ore." That is correct, is it not?

A. That seems to apply to this carrying out of the Elmore process, with the steps mentioned, that of thinning it by heat and centrifugate it, and in that way they reduce the relative loss of oil.

X-Q. 271. What is the measure in pounds of one to three gallons of heavy residuum oil, per ton of ore?

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A. The specific gravity of the oil is given there as .9, so 100 pounds of that would be 90 lbs.—that is, you would have 90 lbs. indicated there as the weight of a volume corresponding to the volume of the ore.

X-Q. 272. From one to three gallons of oil per ton of ore would be how many pounds of oil per ton of ore?

A. Well, I don't know whether I can calculate that off-hand. I don't know the weight of a gallon off-hand, of liquid of a gravity of .9. I could find it in the table.

X-Q. 273. Well, never mind, I will supply the calculation; I thought you had it in your head.

A. No. I can give you the figure any time that I can take the tables and calculate it.

X-Q. 274. Now, let us turn to the tests to which you have particularly called attention, under the heading, "Test, Molybdenite Ores." Now, the first item which you did not read was the mesh, 30. That is very coarse material is it not, for flotation treatment?

A. The ore here is given in these experiments as 30 mesh in the experiment in which the small quantity of oil was used.

X-Q. 275. And I read the part of the description which you did not read, which refers to Nos. 1, 2 and 3, evidently to the Elmore oil buoyancy experiment, but which is followed by the description of the smaller proportion of oil experiments. "Experiment No. 1 showed the presence of middlings, requiring finer crushing to liberate the sulphide."

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A. That was 20 mesh.

X-Q. 276. Therefore that was too coarse for use?

A. For that purpose.

X-Q. 277. "Experiment No. 2 and No. 3 gave practically the same percentage of extraction, but the concentrate in No. 3 was much lower grade than in No. 2." Now, No. 2 was the 30 mesh; that was a little finer, wasn't it?

A. Thirty mesh is finer than the first one, 20 mesh.

X-Q. 278. And No. 3 was 40 mesh?

A. Yes.

X-Q. 279. Now, when they go to forty mesh it says ^{grade of} the concentrates ~~were~~ ^{was} much lower than it was in No. 2. That is to say when they lower to forty mesh they get a lower grade of concentrate? That is it, is it not?

A. But they change the amount of oil between two and three. There is another element comes in.

X-Q. 280. Yes, but it is only one and two thousand k.g.—2000 gms.?

A. Just as it is given there in the other case.

X-Q. 281. And the amount of ore was 1000 gms. in the number 3 and the amount of oil is just a little more than that, about 1200 gms.?

A. 1200, yes, there is a difference in the two.

X-Q. 282. There is a little difference in oil. That is to say, the proportion of oil to ore is slightly increased as 1000 is to 1200? Is that right?

A. That is the difference between those two.

X-Q. 283. Then it says "A comparison of values of concentrate in number 1, number 2 and number 3

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shows clearly that although the finer crushing has freed the molybdenite sulphide from the gangue, at the same time it has produced a larger percentage of fine gangue which, becoming mechanically occluded, in the oil, gives a low grade concentrate." I have read it correctly, have I not?

A. That is correctly stated.

X-Q. 284. Now, following that were experiments Nos. 4, 5 and 6, which it is said "show the results obtained by treating separate samples with small quantities of oil in a salt solution, and agitating violently to produce the foam effect." I have read that correctly, have I not?

A. That is correct.

X-Q. 285. "This method gives the highest grade concentrates of any of the direct treatments here outlined. In experiment number 6 only about 10 c.c. of oil was used for 100 gms. of ore. This gave an extraction of 75 per cent with concentrates running 32.4 per cent molybdenum sulphide." The experiments which gave the best extraction or the best record was the last of these three with 8.9 per cent of oil, was it not?

A. Yes, sir.

X-Q. 286. And the experiment which gave the poorest extraction or recovery was the one in which 2.1 per cent of oil was used, is that right?

A. It is in that report.

X-Q. 287. And the recovery there was 43.5 per cent, and when the amount of oil was increased to 5.3

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per cent the recovery was 47 per cent; and when the oil was increased to 8.9 per cent, the recovery was 75 per cent. That is correct, is it not?

A. I think something must be borne in mind, to-wit, the number of treatments indicated there.

X-Q. 288. Yes. You didn't explain that. Suppose you explain it?

A. I think that that indicates that there was a second treatment and a third treatment.

X-Q. 289. That is after the manner of the Elmore process, when you put the things through a centrifugal and thereby extract the oil and then send it through again, isn't that so?

A. This has nothing to do with the Elmore process whatever; there is no connection with centrifugation here. It is the foam effect. The foam effect is not centrifugation.

X-Q. 290. I call your attention to the fact that that column headed "Number of treatments" runs through the upper three experiments, which are Elmore experiments, and there we have number of treatments four, number of treatments three, number of treatments three, so you know what they mean is the Elmore process, don't you?

A. No, I can't say that I do.

X-Q. 291. Well, it is described in this article, professor, that they put them through the centrifuga! and used it over again?

A. Under it, by the use of a series of cylinders. But the application of the Elmore method under the

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head of additional treatment is not possible where we are trying a foam effect. The foam effect is tried and shown there and described by these writers and it has no possible application to a second or third following of the Elmore; haven't anything to do with it, not the slightest.

X-Q. 292. I don't think you have figured that out, professor?

A. I have not figured out what this "treatment" means because it is not indicated, it is not indicated at all, and therefore I am not prepared to say that that has one value or the other, but I am prepared to say that whatever it is it is not a following of any step of centrifugation or anything else of the Elmore process. That is practically out of the question with the foam method of operation.

X-Q. 293. Now, everything that we have been considering in this table is under the heading "Laboratory methods," isn't it?

A. No, the heading in the case of tests, laboratory methods describes what was found on page 36 of this California publication, laboratory method applies to what there follows: "The mixing or agitating can be done in two different ways. The charge may be agitated very gently, the oil being kept in a single lake, and broken up as little as possible, consistent with a thorough contact of pulp and oil, or the charge may be agitated so violently as to dash the oil up into a foam or froth full of air bubbles, thus a very thorough contact of oil and pulp is obtained. Each method has its

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advantages and disadvantages, and these are discussed later." Now, this is what is implied when he begins the discussion of laboratory methods and the way in which this laboratory—these laboratory methods are carried out is farther described on the same page, page 36: "Three methods of mixing may be used. 1. By inverting the tube several times, thus allowing the ore to fall through the oil. 2. By rotating the tube in a horizontal position, thus throwing the pulp upon the surface of the lake of oil. 3. By violently shaking the tube, thus producing the foam effect, or at least shattering the oil into small globules." Then after that we come to the tests. These tests are not necessary any longer to be considered as illustrative of these laboratory methods, but they are the application of the laboratory method to particular tests of ore for the purpose of arriving at a knowledge of results.

X-Q. 294. Now, just read the first paragraph there, that headed "tests"—molybdenite ore. Read it aloud.

A. "The ore treated was low grade—" that is what you mean?

X-Q. 295. Yes, read that paragraph?

A. "The ore treated was low grade with the values fairly disseminated. The gangue minerals were orthoclase and quartz. Samples were crushed to 20, 30 and 40 mesh, and treated in percolating tubes as outlined above. The details and results are given in the following table."

X-Q. 296. Don't that make it pretty clear that these were laboratory methods?

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A. In the sense that they were small operations, of course they were laboratory methods; but now applied in a quantitative application. The distinction I make is not as between small scale operations and mill operations. That is not my distinction. My distinction is as between the figures which I described. "Methods of operation" as here discussed in this operation are specific tests, and here are some of these.

X-Q. 297. Now, is it not a fact that the only operation described in that table and described there as a laboratory method ~~in the per described there is a laboratory method~~ in the percolating tube carried out with less than 100 per cent of oil and showing a recovery that has any metallurgical value is the operation with 8.9 per cent of oil to the ore?

MR. SCOTT: That certainly is objected to. The doctor has just testified that this was not necessarily a laboratory method, and the question contains the statement that it is.

THE COURT: Well, that different application of terms is all. I think he will not mislead the witness. I cannot drive the doctor to accept his terms or he is not to be driven to accept the doctor's terms.

MR. WILLIAMS: I want to shorten up, your honor.

A. I have granted that these tests were carried out in percolating tubes as stated specifically. I don't call that laboratory methods, but the application of laboratory methods in practice as such on a small scale, but still quantitative because the matter was followed out

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with care in the weighing and followed out with care in the examination of the concentrate, in the molybdenum sulphide which you will note runs higher in experiments 4, 5 and 6, than in experiments 1, 2 and 3, and that is the one case we get the maximum percentage of extraction. In the case of experiment 6 also were small scale experiments carried out in percolator tubes and they represent the application of laboratory method in practice.

X-Q. 298. You have not answered the latter part of the question. Please read the question.

(Question read as follows: "Now, isn't it a fact that the only operation described in that table and described there as a laboratory method ~~in the per described there is a laboratory method~~ in the percolating tube carried out with less than 100 per cent of oil and showing a recovery that has any metallurgical value is the operation with 8.9 per cent of oil to the ore?")

MR. WILLIAMS: The question whether that is not the only one of these less than one hundred per cent operations which shows a recovery having any metallurgical value?

A. I am not prepared to say that was a recovery of metallurgical value because the statement follows immediately after that that these retreatments were not merchantable, but would have to be reconcentrated; but ~~it~~ represents the highest figure in percentage of extraction and the figure is also higher as I say in the value of concentrate, that is *molybdenum sulphide*, than those of the earlier ones. I can't characterize it any more exactly than that.

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X-Q. 299. That is to say in that you only lose 25 per cent of your metal in the operation while in the other two you lose respectively 53 per cent and 56.5 per cent, that is right, is it not?

A. In this first concentrate product those are the figures and the other amounts that you have mentioned are yet to be recovered by retreatment, as specially stated by the authors.

X-Q. 300. And as you read it in experiment 5 there has been a retreatment of the original and with retreatment the recovery has been 47 per cent, is that right?

A. I am not able to say what that means as to the number of treatments. It possibly was not what he called reconcentration.

X-Q. 301. Yo do not know what it means?

A. I do not know what it means. That is correct.

X-Q. 302. And then down near the bottom of the page, as you have the article in the fourth page, following the table, we have a description, have we not, of a No. 9 concentrate having been brought up to fifty percent of molybdenum sulphide?

A. That is reconcentration; that is bringing from—32.4 up to 50.02.

X-Q. 303. And apparently that was the climax of the operation that these students performed.

A. That is as far as they reported it.

X-Q. 304. Now, following this description of the test with molybdenite ore we have a description of tests with copper ore, have we not?

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A. Yes, sir.

X-Q. 305. And no mention of anything less than substantially Elmore oil buoyancy proportions, is that right?

A. We have mention of 1.2 k.g., which means 1200 gms., treated there in a large percolating tube with 500 c.c. of oil which is less than the Elmore amount.

X-Q. 306. And then it states that it was gently agitated for twenty minutes, doesn't it?

A. Yes.

X-Q. 307. So that must have been an Elmore process, must it not?

A. I can't say. The amount of oil was not sufficient for Elmore. I don't know what he means by "gently agitated in a percolating tube."

X-Q. 308. So you think that might be a foam effect?

A. It is some form of agitation.

X-Q. 309. You don't find any description which you can identify as a foam effect, do you, under this heading of copper ores?

A. No, sir.

X-Q. 310. Nor under the heading of gold ores, do you?

A. I believe not.

X-Q. 311. Now, in conclusion, on the last page of the article, the statement is, is it not, that the oil was thrown into a froth which was heavily charged with air or other gas?

A. That is correct.

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X-Q. 312. And then follows the statement that this gas of course gives a greater^{ly} increase^d buoyant force. That is right?

A. That refers to the bubbles so obtained. The bubbles of gas have greater increased buoyant effect.

X-Q. 313. Then it says the oil in this condition assumes a certain load of mineral and holds it in a very stable condition. That is right, is it not?

A. Yes, that is this froth condition.

X-Q. 314. And further it says, "The charge does not settle and overload on standing" and describes the result of the operation?

A. Will you finish that sentence if you please?

X-Q. 315. "As is the case of the lake effect."

A. Yes, there is the distinction made. There is no overload here in the froth effect as there was in the lake effect.

X-Q. 316. What is overloading in the lake effect?

A. The gradual dropping away of the mineral particles from the layer of oil in which they have been first taken, and on standing that frequently is said to result, but by reason of the insufficient buoyant power of the oil or with any little disturbing of the compact layer of oil, this overloading becomes imminent and a dropping out of the mineral takes place.

X-Q. 317. And, as a matter of fact, the mineral and oil together drop out, don't they, the oil being overloaded and not buoyant enough to float, the oil then goes with the material.

A. I am not prepared to say how much oil goes

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with the material that drops, but it is substantially as described. Ore dropping out of the mineral, it must of course be oiled.

X-Q. 318. Haven't you seen these blobs drop down from the Elmore float, here one afternoon?

A. Yes, sir.

X-Q. 319. And these blobs are overloaded themselves so that they can't float by buoyancy? That is true, is it not?

A. It is merely because the buoyant effect of the oil does not suffice to hold up the mineral, and in pulling away it drags oil in some degree.

X-Q. 320. And that oil and mineral together are not buoyant enough to rise to the surface That is right?

A. No.

X-Q. 321. Now, the conclusion is the foam effect is best adapted for light, flaky mineral such as molybdenite? What is that character of lightness and flakiness which they there refer to?

A. Well, molybdenum crystallizes in flat, flaky crystals, and its cleavage and general structural character is that of a flaky condition; and as they tried the experiment with molybdenite and got results which satisfied them, they have assumed that this was the typical form of mineral adapted for the foam effect. Whether that conclusion would have been modified on a larger amount of experimentation is another question. That was their conclusion as stated here, based on what they had done here.

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X-Q. 322. Now I will refer you to the record in the Miami suit, page 1183. Did you not in your testimony there in answer to re-cross 1368 characterize what is described in this article in the California Journal of Technology as "that little foam effect" in the California publication?

A. I did so speak of it because the operation was a small operation and the little foam effect was entirely so characterized because it was done in a percolator. There was no intention to distinguish between much or little volume of foam in any such relative way, but the little foam effect referred to the small tube experiment.

X-Q. 323. Now, we will turn to the Kirby patent which appears on page 738 of the Hyde record, and first we will take on page 738 the drawing on the first page.

A. I have the first page of the drawing.

X-Q. 324. Now, the apparatus indicated by the letter A is the apparatus described in the specification as the mixing tank is it not?

A. Large A, yes, sir.

X-Q. 325. And small a is the revolving plow described in the specification?

A. Yes.

X-Q. 326. Now you said that that curved dotted line above there represents a vortex?

A. I did.

X-Q. 327. Do you adhere to the view that that

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shows a vortex with an opening shown for the purpose of admitting air to the bottom of the vessel?

A. The reference in the patent to the arrows and what they indicate—

X-Q. 328. You have not answered the question. Answer first and then you can explain.

A. I do ~~not~~ consider that that curved line illustrates the direction of a vortex.

X-Q. 329. Well, that is the whole question.

MR. SCOTT: You may explain now, if you wish.

A. I consider that it refers to a vortex, and I think I am justified in taking the two things together, the statements of the patent that the direction of the arrows indicates that there is a current, as stated here—"which result is facilitated by the current as created in the charge by the action of said plows, the direction of said current being indicated by the arrows in Fig. 1." Now, if we have the current established as indicated by the arrows, it is undoubtedly a vortex. I think the appearance of the curved line was an illustration of a vortex, designed to additionally confirm that statement, that there are produced a series of currents which, with rapid rotation means the production of a vortex such as is very easily seen by any of these rapid rotations when in motion, and that means the entraining of air.

X-Q. 330. MR. WILLIAMS: Now, how, according to the specification, is that mixing tank operated; what functions are performed in that mixing tank according to the specification? '

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A. I find that on page 1, line 68: "First, in thoroughly agitating it together, the pulverized ore or mineral material. B, enough water to make the said pulverized ore a flowing pulp. C, a solution of bitumen in addition to a distillable hydro-carbon liquid, as kerosene. These materials to be so thoroughly agitated together as to finely subdivide said solution into small globules and bring said globules into contact with substantially all of the pulverized mineral particles which will, by preference, adhere to them.

Now, there are statements as to what are the components of the mixture there, statements that we have thorough agitation of the mixture; statements that the materials are so thoroughly agitated as to be finely subdivided in the solution in small globules.

X-Q. 331. What is the solution?

A. The solution, meaning kerosene holding some bitumen in solution.

X-Q. 332. That is to say, the oil is broken up into small globules of oil; that is right, isn't it?

A. Yes, then it says, "and bring said globules into contact with substantially all the mineral particles which will by preference adhere to them." I simply say—I don't add anything to it—but I simply say that you cannot realize that result without entraining air, and therefore air bubbles are there, which, with the kerosene or kerosene solution, is the film-forming material or effective in forming the froth.

X-Q. 333. That is to say, entraining air and keeping it?

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A. Entraining air so as to produce froth. It may be called beating in, just as truly as the action of the cone-separator is called beating in.

X-Q. 334. Then you think that in the mixing tank a froth is produced?

A. I do.

X-Q. 335. Now, where is that froth separated in this apparatus?

A. If the mixing tank is used as a separate feature, it has to pass into the separator.

X-Q. 336. The separating tank?

A. The separating tank. If, as Kirby says, one tank serves both purposes, than the froth is raised in the separating tank.

X-Q. 337. I asked you about the mixing tank. Is the mixing tank ever used as a separating tank?

A. No, it is not.

X-Q. 338. Therefore the froth is never taken out in that mixing tank, A, according to that specification; that is right, isn't it?

A. It is not calculated to be taken out there; it is calculated to be taken out in the tank where we have shown the skimming device.

X-Q. 339. That is tank B; that is the separating tank?

A. That is right.

X-Q. 340. And now, everything else which you have described as supplementary takes place in that tank B, doesn't it?

A. After the conclusion of the thorough agitation, whether that takes place in one tank or the other.

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X-Q. 341. Well, it does not take place in the mixing tank, you admit that?

A. The second operation is not calculated to take place in the mixing tank.

X-Q. 342. And there is no description of that in this patent—of any separating operations taking place in that mixing tank; that is true, isn't it?

A. That is true, yes; I have said that.

X-Q. 343. So that whatever separation takes place in the apparatus shown in Fig. 1, takes place in the separating tank B, that is right, isn't it?

A. This is so figured.

X-Q. 344. ~~You think~~ separating tank B would have the streams of oil flowing in—in that we have streams of oil flowing into the pulp; that is one of the things that is described?

A. I don't quite understand what you mean there.

X-Q. 345. I am taking the words of the specification.

A. What do you mean when you refer to streams of oil?

X-Q. 346. The language of the specification is "fine streams of the solution," page 1, lines 84 and 85.

A. That is in the second step.

X-Q. 347. I am talking about the separation in the separating tank B.

A. That is the separation; that is supplemental. If you will read the paragraph beginning "Second" we have this stated clearly: "In allowing the hydrocarbon coated particles to flow to the surface of the

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mass." That is his separation; "and in rendering this separation substantially complete by a second step."

X-Q. 348. Rendering that separation substantially complete?

A. "By gently agitating the mass and injecting gas into the same, and preferably also discharging into the mass fine streams of the solution." That is the secondary step. It is not any part of the step which forms the froth, and the froth has already floated to the surface before that is started. That is the clear meaning of these words.

X-Q. 349. That is to say, what you call the primary step and what you call the secondary step take place in the separating tanks, don't they?

A. The froth is entirely separated there in tank B; you are correct about that.

X-Q. 350. Now, in this tank B we have first the material, which has been agitated in tank A, and that is the material and all of the material which flows into the tank B; that is right?

A. That is right, just as it flows off into a spitzkasten.

X-Q. 351. Now, in tank B we have fine streams of the solution or oil discharged at the bottom of the tank, have we not?

A. It may be done.

X-Q. 352. It is so described, is it not?

A. It says it may be done: "By injecting gas into the same, and preferably also discharging into the mass fine streams of the solution." That is one of the

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supplemental steps, just as the discharging of the gas is, and it may be done. It is not prescribed as a necessary feature, but I suppose he considers it an advantageous matter.

X-Q. 353. In the description of the operation of this apparatus shown in the Fig. 1, this is said, is it not: "That the hydro-carbon liquid is delivered through small pipes parallel with the side hollow arms through outlet 25—25." That is the description, is it not?

A. I must connect that up first. That is correctly stated as to what takes place when the hydro-carbon liquid is used in that way, "preferably discharged in fine streams" as part of the second step.

X-Q. 354. But it does not say here that you do it preferably; it says in this part of the description that you do it, isn't that right?

A. There is no question here—no qualification here; it just says that it is delivered in that way.

X-Q. 355. And it is true, is it not, also that "gas is injected into the pulp in the separating vessel B." That is true, is it not?

A. That is correct. "Injecting gas into the same" is found on page 1.

X-Q. 356. And that is accomplished through air jets in the rotating stirring plow, is it not?

A. We have figured in Figure 1 the same form of rotating apparatus which is operated at two different stages of the operation, and operated at different rates of speed and for different purposes. The operation in

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the first, or mixing tank—or if you perform that operation first in the separating tank and make one tank to function for both, that operation—that is not involved in the injecting of the air in the way that is now mentioned; that only comes in when the rotating apparatus is slowly rotated in the second step, and for the purpose of yielding small rising bubbles of air which will carry out of the gangue the mineral which was not raised in the froth in the first step. That is clearly shown.

X-Q. 357. And your first step and your second step are completed in the same vessel, is that right?

A. They may be; not necessarily—oh, yes, they are both completed in the same vessel, you are right.

X-Q. 358. Of course I have in mind, as you have repeatedly said that it is described in this specification as a modified instruction that you can do everything in this second vessel; that is true?

A. That is true; it says that that can be done. That is stated on page 3 of the patent, line 115. "This separate tank for performing the mixing operation is not necessary for my process, although it is preferable in some cases; as where a continuity of discharge is desired. The mixing may be done just as well in the separating tank, which can then be termed the mixing and separating tank, all in one. It is merely necessary to rotate the agitating apparatus rapidly when mixing"—and that is when I say the froth is formed—"and rotate slowly when the separation is being made." There are two different stages and two results.

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X-Q. 359. And one separation?

A. One final separation, yes.

X-Q. 360. One operation of separation?

A. No, I don't say that; there is one final separation. I have already called attention to the fact that on page 1, lines 79 and 80, we have a clear statement that the hydro-carbon coated particles float to the surface of the mass, and then we render this separation more complete—I think I am justified in saying that the separation is there indicated as well as later.

X-Q. 361. Put it says "in rendering this separation" does it not?

A. Well, it means the separation of the minerals, yes.

X-Q. 362. Now, as a matter of fact your theory tacks on the first part of the second step to the first step, in reading those two paragraphs page 1, commencing line 68 and ending line 87; that is true, is it not?

A. That gives the first and second steps, those two paragraphs.

X-Q. 363. And you tack on the first part of the second paragraph as the tail end of the first paragraph, don't you?

A. We can not connect the two except by stating what you have to start with on the second.

X-Q. 364. Don't you tack those two together as the first step of the process?

A. I use these first two lines of the second paragraph as referring to the results of the first step.

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X-Q. 365. Then they are not the first step, but only the result of the first step. Have we advanced that far?

A. Yes, they are the result of the first step.

X-Q. 366. What you regard as the result of the first step?

A. Yes.

X-Q. 367. In that second step we have the result of the first step, and we have the other things which you call supplemental?

A. That is right.

X-Q. 368. And those things all go on together?

A. They all finish together.

X-Q. 369. And the things that you call supplemental are in operation at the same time; it is a continuous operation, is it not, as described here?

A. Oh, you are—you can not talk about the first step and the second step as being in operation at the same time. There is a sequence, of course.

X-Q. 370. This is a continuous operation, is it not, as described?

A. He says if you use the mixing tank and separation tank, that you can make the operation continuous; otherwise not.

X-Q. 371. The ~~separation~~^{specification} says that this apparatus may be used continuously?

A. If you use the two tanks.

X-Q. 372. Well, I am referring now to tank 1.

A. Yes, that can be made continuous; that is what the patentee says.

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X-Q. 373. Now, we will operate it continuously. In tank A we have agitation?

A. Yes.

X-Q. 374. Or mixing, and nothing else; that is all, isn't it?

A. With its results.

X-Q. 375. We have in that tank—

A. That is the only operation, agitation.

X-Q. 376. In tank B we have separation, have we not?

A. We have first of all a supplementary operation for the raising of additional matter, which we stir up, and the separation of that is the final separation.

X-Q. 377. In tank B we have separation; that is the separating tank?

A. The ultimate separation.

X-Q. 378. That separation is going on continuously, isn't it?

A. Apparently.

X-Q. 379. And in that continuous operation of separation we have the rising of the hydro-carbon coated particles to the surface and the assistance of this hydro-carbon coated particles by the streams of air and streams of oil flowing in at the bottom from the gently rotating agitator arms, isn't that right?

A. That is right, and not as a second operation continuously, but the results of the first operation are passing in, and therefore it is a reinforcing step as I consider it, so that we have the flow passing in and constituting the important operation as I have ob-

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served in practising this—the major portion of the operation, and then this causes the rising of the additional entrapped material, which adds to the amount of the floated material, and they together are skimmed off.

X-Q. 380. So you call it a secondary operation because it assists the rising of the hydro-carbon coated particles to the surface.

A. It brings those up which are entrapped. It has nothing to do with what has been done in the first tank.

X-Q. 381. It assists the flotation?

A. It assists the ultimate results, some.

X-Q. 382. It does it at the same time; it is a continuous operation?

A. It can be made continuous according to the author.

X-Q. 383. Well, we have taken it as detailed here, and it is continuous?

A. Yes.

X-Q. 384. You call it secondary, although it takes place in the same vessel and at the same time, is that right?

A. Now, Mr. Williams, you are going back to the same vessel; I have been talking about two vessels, and so have you just now.

X-Q. 385. The separation is what I am talking of.

A. (Laughing.) There is a result from the work of the first vessel which is being passed into the second vessel, which is being supplemented, I say, by

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work done in the second vessel, and that work done in the second vessel is what I speak of when I refer to the introduction of air and streams of liquid; that is working in connection with a slow rotation. The other operation is distinct from that operation, and takes place in a distinct vessel; it precedes it in the order of sequence, and the sum total of the two gives the ultimate froth which is taken off by the skimming bar.

X-Q. 386. Although they take place in the same vessel at the same time?

A. No, I don't agree to that.

X-Q. 387. They take place in the same vessel, don't they?

A. They can, but if so there would be two acts; they would be discontinuous in that case.

X-Q. 388. You say they can take place in the same vessel?

A. That is what the author says.

X-Q. 389. There is not a word of description of the separation taking place in any other vessel than the separating tank B?

A. I have said that the ultimate separation takes place in B, yes.

X-Q. 390. And the separation which takes place in B is a separation by buoyancy, suppose we say.

A. We only get the froth after it has been first subjected to agitation. There is no froth separated, but there is the potential froth of the agitated mixture, of course.

X-Q. 391. And it is not separated in that vessel?

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A. It does not separate in that vessel.

X-Q. 392. Therefore, if we are to attempt to repeat the Kirby operation we must have in one vessel a separation by the buoyancy of something, assisted by streams of air and streams of oil; that is right, isn't it?

A. If you want to carry through the Kirby operation in full detail as described in the patent you have to do as I say. If you want to prove that the Kirby first step produces a froth, you do not need to trouble yourself about the supplemental steps.

X-Q. 393. You don't need to assist it?

A. You don't need to assist it.

X-Q. 394. Your froth is not in need of assistance, is it?

A. It is not in need of assistance; we had it here produced excellently in the square jar.

THE WITNESS: Mr. Williams, may I still further state my proposition about the two steps, a moment?

MR. WILLIAMS: Yes.

A. I would like to call your attention to the paragraph beginning line 95 on page 1 of this Kirby patent. "It is thought that the use of a gas--of this gas assists in the flotation of the coated particles as set forth in the description of the second step of the process as described." I think that gives us abundant justification for stating as I say that there was a supplemental step which involved this introduction of a gas in the bottom of the separator vessel.

X-Q. 395. Well, we will have to go back to this paragraph commencing on page 1, on line 68. Now,

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we have here four paragraphs, and each paragraph sets forth a step, does it not?

A. There are four paragraphs which set forth consecutive steps, as I see it.

X-Q. 396. Now, in the first step and in fact the paragraphs are introduced by the statement that, "The process consists in the following steps"—in the first step we have agitation and whatever happened during agitation? That is right?

A. That is right.

X-Q. 397. In the second step we have separation of the metal or the mineral from the gangue and whatever happens during that separation, that is the second step, isn't it?

A. Yes, but in that second paragraph there are two steps, and as I said the first and second line of that paragraph connect with the first paragraph because that expresses the result of it and then you go on to state the details of the second step.

X-Q. 398. Well, now, isn't it reasonable and logical that a second step, to wit, separation, would be described as a second step even if it were the result of the first step, to-wit, agitation? That is logical, is it not?

A. Yes, but I have frequently just seen this way of statement—have frequently seen just this very thing in connection with the step of a patent, by connecting it with that which preceded it, and that is what was done here.

X-Q. 399. The second step of the Kirby process

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as described is separation. That is true, is it not?

A. The second step is—

X-Q. 400. Separation?

A. Is the supplementary treatment for rendering separation substantially complete, it is not separation as expressed under the conditions as stated.

X-Q. 401. Well, where do you put the separation which occurs from allowing the hydrocarbon coated particles to float to the surface of the mass?

A. Now, if you will analyze the last sentence of the second paragraph wherein the separation is compared, that indicates that there are parts of the separation which are to be taken together before completion. Now we have the first part of the separation stated and the result of step one. In the first and second lines they state how this separation is substantially completed or made more effective by doing something else. That is step two, and then the last sentence says when the separation is completed—something they do by agitation and they do by the injection of air—then the floating hydrocarbon concentrate is removed for subsequent treatment. Now, we are ready to take it off by the skimmer.

X-Q. 402. Now, we are ready for the third step of the process?

A. The third step comes in, yes.

X-Q. 403. The second step is separation?

A. In the several stages as described.

X-Q. 404. In that one vessel, separation?

A. Separation is the ultimate result in the second vessel.

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X-Q. 405. And when the apparatus is operated continuously that separation produces a float on the surface of that vessel, doesn't it?

A. The float is the final result of the separation which is here described in its several parts.

X-Q. 406. Well, does Kirby describe that flotation as occurring in several steps, or does he describe it as a continuous operation, as one continuous thing? Which is it?

A. He certainly gives the several steps whether you secure them one following the other, or whether it is discontinuous because he says if you want a continuous operation you use the mixer and the separator vessel; if you do it all in one vessel.

X-Q. 407. Now, we will do it in one vessel.

A. If you will just notice the line beginning 114 on page 3: "This separate tank for performing the mixing operation is not necessary for my process, although it is preferable in some cases and where a continuous discharge is desired," and what is the antithesis of that?

X-Q. 408. You read that over before?

A. I know. What is the antithesis of that?

X-Q. 409. I am not answering your questions, doctor. Please answer mine.

A. I was just trying to argue.

X-Q. 410. We will come to the intermittent operation. I have been trying to get you to make a picture of the continuous. Now we will come to intermittent operation. Now, in the intermittent operation what is the first step that takes place?

P. 3730, L. 15, insert " don't wish to make it contin
operation, then you can " after " you "

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A. The intermittent operation would take place by doing everything in one vessel.

X-Q. 411. And what is the first step?

A. The first step is a rapid rotation.

X-Q. 412. What is the second step?

A. The second step, following the stopping of the rapid rotation giving time for the result of it, was that you slowly agitate so as to supplement the result of the rapid agitation.

X-Q. 413. Where do you find in this specification that he gives time for results?

A. I will tell you. "The mixing may be performed just as well in a separate tank"—page 3 near the bottom—which may then be termed the mixing in the separate tank. Now, it stands to reason that you can't do both at the same time. Therefore you rotate it rapidly at first and then rotate it slowly when the separation is then made. That means that the ultimate result called the separation is being made or in other words is being supplemented or completed by this slow rising of air bubbles. Then it is slow rotation and the separation is done by the skimming off.

X-Q. 414. Do you find in these specifications any statement that any aeration results from that rapid agitation?

A. Not by name.

X-Q. 415. And the only aeration that you find described there is an aeration which takes place during the gentle agitation by letting in streams of air at the bottom. That is right, isn't it?

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A. That is described as the releasing of particles by air bubbles, which you would call aeration probably, but it is not in the sense in which I used the word aeration at first.

X-Q. 416. Now, the purpose of the injection of the gas is described in the specification, is it not? The purpose of the injection of air at the bottom of the separating tank is described in this specification, is it not?

A. That is described particularly at the bottom of page 412, first column.

X-Q. 417. Give the page of the specification?

A. Page 2 of the patent, beginning with lines—well, I will begin in order to include the whole operation, with line 53: "Some of the hydrocarbon coated particles will float to the surface without assistance; but a considerable quantity of such particles will not be sufficiently buoyant and some of such particles and some globules of the mixture would be trapped in the sands." That is the whole object of the second step of the operation.

X-Q. 418. "Globules of the mixture" means globules of oil, doesn't it?

A. Undoubtedly, but it also include air bubbles, must do so, as a result of what we have already done. "In order to recover this less buoyant material together with the globules of the mixture, the mass which tends to settle is slowly lifted and turned over, to liberate the coated particles and the globules, and at the same time a gas, preferably air, is blown into the mass

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preferably near the bottom thereof." Now, then, follows his description of just what the oil bubbles do in that second step. They bring up the additional particles. But we have third steps as particularly clearly represented on page 1, beginning there at line 95, the fact that this injection of gas is a mere feature, not the main result: "It is thought that a use of a gas to assist in the flotation of the coated particles—"

X-Q. 419. Then it says, does it not, "that the employment of a gas in the manner stated brings in a more powerful floating agency than anything before used, which results in the recovery of this floured oil together with numerous coated particles which would not otherwise be floated." That is a statement of the specifications, is it not?

A. That, connected with what immediately proceeds it; that connected with his talk about the use of his gas step in connection with viscous oils.

X-Q. 420. That is to say, the Elmore process?

A. Yes, that is the Elmore process. That does not refer to this process.

X-Q. 421. Now, doesn't he say at page 2, line 54: "The injection of a gas, preferably air, into the mass which is the chief novel characteristic of the second step of the process, assists in the flotation ~~of the second step of the process, assists in the flotation~~ of the hydrocarbon coated particle." He says that; he says it is the chief novel characteristic of the second step of his process, does he not?

A. What is the line?

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X-Q. 422. Line 54, I guess that is it, 54?

A. Yes, I see it.

X-Q. 423. He says that is the chief novel characteristic of the second step of the process, doesn't he?

A. Yes, of the second step of the process, and assists in the flotation.

X-Q. 424. And then when he ~~used~~^{said} "some of the hydrocarbon-coated particles will float to the surface without assistance" you read that as meaning some of the hydrocarbon-coated particles to which air bubbles have been attached, did you?

A. I did because they are the hydrocarbon particles which already have been taken care of by the first rapid agitation.

X-Q. 425. Now, when you read a description of this float which was taken off in the second vessel, there was one part of that description that you did not read. That commences on page 3, line 55: "The floating concentrates are carried mainly at the lower surface by the hydrocarbon layer where it is ⁱⁿ contact with the water." Now, isn't that a description of an oil buoyancy float, by its principal characteristic?

A. I have given that clause a great deal of thought and I have turned farther over to where the same form of statement appears a little fuller on the next page, on page 4 of the patent, where it says in line 20: "Most of the concentrates hang near the contact between the hydro-carbon and water, and as this contact surface becomes over-loaded with concentrates, some of them sink to the bottom of the tank." I think that describes

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What we have seen in looking at that square glass cell. It is always observable that there was a gradual dropping away, that dripping away takes place in the case of the air froths quite as obviously as in the case of the overloading of the Elmore solid oil layer. I don't think, from the whole description, that that is necessarily any indication that he had a meaning there of a solid mass of oil or layer of oil when he spoke about the hydrocarbon layer. "Hydrocarbon layer" there means the layer which is just above the water. Now, in my opinion, and I think I am justified in that by studying the matter—in my opinion that hydrocarbon layer there referred to is now an aerated layer from which mineral will slowly drop, and this is there referred to. I cannot connect it with the idea of an Elmore bulk oil result simply because I cannot take the Kirby process and forget the violent agitation. If you could, if you could forget the violent agitation of the Kirby process as the first step then you could work it out very nicely.

X-Q. 426. So you think that the statement that the floating concentrates are carried mainly at the lower surface of the hydrocarbon layer where it is in contact with the water describes a flotation froth carrying mineral particles on the bubbles? Is that right?

A. I think so.

X-Q. 427. And then this second description that illuminated your view, that is of something that takes place in another vessel, isn't it, afterwards?

A. Well, I cannot say whether that is right or not.

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Yes. And I think this second description throws light on it because the same feature or the same observation, or the fact that there was a certain dripping away takes place after having spoken of the distinct breaking up by a stirring apparatus of the concentrate froth. Now, the stirring apparatus, 42, described on page 40^f of the patent, line 17, the stirring apparatus 42 has its arms revolving gently within this layer so as to break up and discharge the air bubbles, and assist the separation. Then he goes on: "Most of the concentrates hang near the contact between the hydrocarbon and water, and as this ~~constant service~~ ^{contact surface} becomes overloaded with concentrates, some of them sink to the bottom of the tank." That is after all the separation is completed, after the so-called skimming has been done, after the concentrates have been washed by passing over water which is moving, in motion, and after that it is desired to break up the concentrate. Now, he stirs them gently to break them up. And, as I understand, most of the concentrates hang near the contact of this froth layer.

X-Q. 428. Oil and water? He don't say "froth layer," he says oil and water?

A. No, I mean out where he commenced there, in the froth layer.

X-Q. 429. You don't think it is a froth still there?

A. I think the froth has not been completely broken up and I will call your attention to line 31: "The concentrates which fall to the bottom of the tank, accompanied by the hydrocarbon which adheres to them, are

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drawn off in a thick condition." I consider that an illustration of a frothy mixture; the concentrate is in a thick condition.

X-Q. 430. Read a little further, the two streams—commencing at line 37: "The two streams, one of hydrocarbon and concentrate, the other mainly of water and concentrate, may either be filtered in separate apparatus or united and put through the same apparatus, as is found most convenient." Now, what are those two streams?

A. Well, one is the stream of hydrocarbon, distinguished from that which is here described by the expression "hydrocarbon and concentrates," and the other is the stream of water into which some of the broken down froth has gone, some mineral matter, because the breaking down of the concentrates has been described. And yet, after that description of the breaking down of the concentrates they are described as in a thick condition.

X-Q. 431. As a matter of fact, in this vessel "C" there is a separation, is there not, into two streams, one of which is a stream containing a great deal of oil and the other of which is a stream containing a little oil and water? Is that right?

A. There has been by this time a breaking down and the oil and the water form these two streams, but the description in line 37 to which you called my attention, still illustrates the fact that the concentrates are present carried along in the hydrocarbon layer. There is a hydrocarbon layer now because the froth

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has been broken down very largely and I remember Kirby used a large amount of oil. With an amount of oil varying from 25 to 75 percent it is undoubtedly true that when you break down the concentrated layer you would have free oil showing.

X-Q. 432. And you think that that slowly rotating stirring apparatus 42 brings up the froth; is that your idea? And the froth—the metal immediately goes to the bottom?

A. It is stated there to be for the purpose of discharging the air bubbles. That means breaking up the froth.

X-Q. 433. Did you ever see an Elmore float with air bubbles in it?

A. I have seen layers of oil with imperfect frothing conditions and a few bubbles of gas in it.

X-Q. 434. Do you call that an imperfect frothing condition, an Elmore oil buoyancy layer with a few bubbles in it acting like pores in a cork?

A. I do not know where you draw the dividing line. I said "imperfect froth" meaning that the oil was in large excess.

X-Q. 435. What is the next step from the Elmore oil buoyancy layer with a few air bubbles, is it upward or downward?

A. That is just as expressed in the experiment about which we were talking.

X-Q. 436. 'What is the next step? Tell me. What is the condition that you get?

A. You just want me to describe it?

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X-Q. 437. Yes.

A. That is shown in the experiment in which we took 25 per cent of kerosene oil, and first tried the Elmore effect and got quite a little flouring, quite an amount of flouring. The same mixture, without any change whatever, was violently agitated and the whole of it was changed into the aerated froth, so that we changed from one step to the other.

X-Q. 438. Is there an emulsion step in between, oil emulsion step in between?

A. I wouldn't call it so. I would call it an air froth.

X-Q. 439. Is there an oil froth in between?

A. I don't understand the distinction between oil froth and air froth.

X-Q. 440. And you do not recognize the emulsion condition as between the froth and the solid oil?

A. Well, an emulsion of air and oil I call a froth. An emulsion in the pure sense of the word means the commingling of two different immiscible liquids, as in the case of oil and water which, in the presence of certain emulsifying agents can be so thoroughly subdivided that they will not subdivide into layers. That is what we call an emulsion proper.

X-Q. 441. That is a pure emulsion?

A. We have a so-called emulsion by soap and other emulsifiers and other emulsifying agents, as I say—we have a so-called emulsion by soap ~~and water~~ and other emulsifying agents, but to call a mixture of air and oil an emulsion is not quite accurate.

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X-Q. 442. Is it possible to have a floating emulsion?

A. Well, I don't know. I suppose there are circumstances under which you could get an emulsion floating on some other liquid.

X-Q. 443. Is cream a floating emulsion?

A. Cream is a floating emulsion.

X-Q. 444. What is the condition of that floating emulsion; what is it made up of?

A. It is made up of the butter fat thoroughly emulsified with the solution of the soluble components of the milk, and kept in emulsion because of the presence of certain protein material which is in the milk.

X-Q. 445. What is the condition of the butter fat in the cream? You say "thoroughly emulsified," but just describe it so that the court can get a picture of it?

A. I haven't studied it strictly or under a microscope so I can't answer that question from that point of view. I would say that the butter fat was thoroughly emulsified in very finely subdivided conditions through the soluble portions of the milk and if you can bring about a coagulation of the butter fat then you begin to break up the emulsion and you get the formation of a more or less clotted condition which ultimately gives us the butter separation.

X-Q. 446. Now, the emulsion condition is a condition ⁱⁿ which the oil or fat is ~~so~~ ^{sub} divided into very fine particles commingled in a liquid in that emulsion condition?

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A. I don't want to pose as an authority on emulsions as some other person could, but these are some of the conditions of an emulsion in the case of a cream.

X-Q. 447. And I suppose you are aware that it is possible to so treat milk that the butter fat globules will be broken up into such fine particles and the emulsion will be so fine that there will be no separation into cream. I presume you are aware of that, are you not?

A. I know that it can be held up for a period of time.

X-Q. 448. That is the condition of homogenized cream, you know that?

A. Yes.

X-Q. 449. Don't you know that can be held up indefinitely by dividing that up into particles of one micron?

A. I am not prepared to say. I don't know.

X-Q. 450. In an air froth or an oil froth, whatever you care to call it, containing metalliferous mineral particles, are the metalliferous mineral particles carried in the lower layer in contact with the water?

A. They are distributed over the whole surface of the film which comprises the froth, but in passing there—but on standing there is very frequent separation from a froth which at first was well defined, with sharp lines, but on standing, just the dropping away that may be ^{due to} ~~seen~~ the breaking up of some of these air cells and depositing their load.

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X-Q. 451. That is in fact due to the breaking of bubbles, isn't it?

A. That disintegration in some cases—I don't know that I have studied the problem of that disintegration to see just what are the conditions most favorable for it—but I have observed it frequently.

X-Q. 452. But in a true mineral froth, so long as it maintains its stability, the metalliferous mineral particles are distributed all through the froth in the surface of the bubbles? That is right?

A. On the surface of the air cells, yes, sir

X-Q. 453. Now, it is a fact, is it not, that the Kirby specification enlarges upon the use of a thin hydrocarbon liquid in place of the thick viscid oils used by other inventors, as one of the most important features of his invention. I refer to page 4, commencing with line 52 of his specification.

A. He says, in line 52, that the advantage of the thin hydrocarbon oil in place of the thick viscid oil used by other inventors is for one particular reason. He states that the use of the thin oil makes filtration comparatively easy and permits cheaper methods than the centrifugal machine and the filter process. He contemplates a large amount of oil, from 25 to 75 per cent., and he did not desire to have all of that oil burned up with the concentrate in the end. He desired, and in that way he contemplated a recovery of the oil ultimately, and filtration is the method he referred to, and with a thin oil it is obvious that filtration is more easily practised than with viscid oil, and does

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way with the necessity of using centrifugals. That is the feature described in the California Journal Technology as part of the Elmore improved process.

X-Q. 454. And he also speaks of the advantage of being able to separate practically all the oil by distillation?

A. In case of the addition of distillable oil, that is the theory.

X-Q. 455. That is the fourth step of his process, referred to on page 1?

A. Yes.

X-Q. 456. The third step being filtration?

A. Yes.

X-Q. 457. The fourth step is distillation?

A. Yes.

X-Q. 458. Have you ever seen the Kirby process in operation as described in the specification, with the employment of everything that is described in the first step and the second step, as there described on page 1 of the specification?

A. I have never seen the carrying out of the second step by skimming off with the skimming bar; I have never seen that practised. I have only practised and witnessed the operation of the Kirby process insofar as it was desirable to settle the question as to what was the result of the Kirby process carried through the first step to see what the result of that was. The supplemental step I never practised.

X-Q. 459. I asked you if you had ever seen carried out everything that is described in the first and second paragraphs, the first and second steps.

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A. Not in the second paragraph, no, I have no

X-Q. 460. Did you see that done at the Mian trial in your presence by the plaintiff?

A. I did not see the Kirby process illustrated in that way at all.

X-Q. 461. Did you see the Kirby apparatus operated?

A. I don't recall that I saw that process of skinning.

X-Q. 462. Well, if your recollection was complete you would remember that there was a slowly rotating skinning bar at the top, which pushed the flowing layer of hydro-carbon, floating particles with a few air bubbles in it, and that they were collected. Don't you remember that now?

A. I don't recall the experiment, no.

X-Q. 463. And it was repeated in the Circuit Court of Appeals in Philadelphia, wasn't it, and you were there?

A. I didn't see it.

X-Q. 464. You said today that the Wolfe patent which appears in complainant's record in the Hydro case, Vol. 3 page 966, discloses an operation which necessarily produces a froth, is that right?

A. I said that the operation of what Wolfe describes as the rotating turbine, which is otherwise described as the Johnson mixer would necessarily produce a froth if rotated with a flowing ore pulp and the oil under the conditions that are shown.

X-Q. 465. That is to say that the sulpho-chlorinat

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oil used as it is described in that patent, would overflow as a froth; is that your understanding of the disclosure of that patent?

A. That disclosure of that patent is that the sulpho-chlorinated oil, as stated in line 68 and following page one—the sulpho-chlorinated oil adhering to the mineral of the ore, floats. Now, that follows after we have had the rapid rotation of what he calls the turbine wheel in the mixture of ore and pulp. I have never experimented myself with the sulpho-chlorinated oil, therefore I am only judging by my belief of what it is for, and what purpose it would accomplish. I am also strengthened in that belief by the testimony of Mr. Culman that he thought they were efficient baffles, and that the Johnson mixer was capable of acting as a substitute in the same way as the Gabbett cone mixer, and then about the description here in the patent of the circulation, set up in the vessel, I believe that we have there a vortex motion which would of course develop aeration as the result of the rapid rotation.

X-Q. 466. But I asked what would happen in this process.

A. I don't know what sulpho-chlorinated oil is,—good oil, or what type of oil it is from any personal knowledge.

X-Q. 467. You don't know what happens in that process?

A. Not from personal knowledge.

X-Q. 468. Now referring to the testimony of Dr.

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Liebmann in the Hyde suit at page 557 volume 2 of complainant's record.

A. I have that.

X-Q. 469. You quoted that, as I understand it, as a description of a normal Froment operation. You certainly applied it to what you regarded as a normal Froment operation, did you not?

A. It is a description of a test tube experiment carried out by Dr. Liebmann, and what his proportions were does not appear clearly. He said, "the amount of carbonic acid which could have been evolved was so small that it would have been dissolved in the water which was present." That was my quotation. I quoted that to call attention to the fact that Dr. Liebmann, as well as myself, recognized what a moderate amount of carbonic acid would be absorbed, and unless there was a very large evolution of carbonic acid and very expeditiously, that we had to consider only the gas which was not dissolved, the excess, in determining how much it would contribute to the air mixture which would form the bubbles.

X-Q. 470. Do you know whether or not that was a description of a normal Froment operation?

A. I think that he presents that as an illustration of what Dr. ~~Bills~~^{Byrnes} had done in connection with the Froment patent, and he claims that there was an insufficiency of oil in answer to cross question 59.

X-Q. 471. He also said, did he not, that there was a total insufficiency of sulphuric acid—for the purpose of assisting your determination of this matter, if you

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will turn to page 555, you will see that this commences with the reference to a certain paragraph in question 34. Do you see that?

A. Yes.

X-Q. 472. Now, if you will turn to page 475 you will see that the paragraph which is following the last paragraph on page 475—You will see that that is the same paragraph; “I took 10 grams of defendant’s ore which had been crushed to an 80 mesh, mixed with 30 c.c. of water, and added thereto .036 grams of sulphuric acid (which I had to dilute in order to be able to convey it into the test tube) and 1 drop of cotton-seed oil.” That is the description of the experiment.

A. Yes, but does that description give you the amount of calcite?

X-Q. 473. If you will follow it up—

A. Because the sulphuric acid and the calcite are the two things that react.

X-Q. 474. If you will turn to defendant’s record page 165 you will see on the preceding pages the reference to Dr. ~~Brown~~^{Bynes} experiment, and you will find that Dr. ~~Brown~~^{Bynes} was carrying on Froment, not only with insufficient sulphuric acid, but without putting in any calcite.

A. Oh, I see. Well, I can not understand that that experiment was normal, if the calcite was omitted, because the whole feature of my illustration of Froment was to follow Froment’s example as given in his Italian patent, in which there was 1 gram of calcite for every 10 grams of ore, and 2 drops of sul-

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phuric acid. Now, I calculated that that 2 drops of sulphuric acid could not decompose more than a fraction—more than one-quarter at the outside, of the calcite, and under those circumstances the total amount of carbonic acid gas which could be gotten, without reference to this dissolved in the water, as not more than half of the contents of the tube, and I called attention to Dr. Liebmann's statement there as to the solubility of the carbon dioxide in the water when a moderate amount was produced, as backing up and substantiating my view that the carbonic acid would not play a very large part, and under the increased pressure which for a moment exists when the tube is closed and shaken, you have much more than one atmosphere, and I do not believe that that amount of carbonic acid would do more than start the reaction. In the experiment which I carried out, with very violent agitation for a few moments, there was not a great deal of excess pressure developed at the cork.

Now, these operations to which you refer, when you referred to that testimony of Dr. Liebmann, are representations in the test tube proportions of these experiments described by Dr. ^{Wm}Burns, and also to repeat the Froment British patent?

A. Yes.

X-Q. 475. And in those experiments he took Black Rock ore; he did not put any calcite, and he used one cubic centimeter of sulphuric acid to 492 grams of ore, and 1700 c.c. of water. Now, that was not a Froment operation at all, was it?

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A. Well, I could not say that it was; I would have to calculate it out.

X-Q. 476. And you will agree that Dr. Liebmann thought that any carbon dioxide that would be produced under those circumstances would be dissolved in the water and therefore useless in the process, would you not?

A. The 1 c.c. of sulphuric acid would have to act upon the manganese carbonate in the Black Rock ore, and apparently it was not acting enough. I would not, myself, at all, illustrate a—illustrate the Froment experiment that way.

X-Q. 477. Now, referring to the British Froment specification and these words which I think are the same in the British patent as in the Italian—Froment says in the British specification, page 2, commencing line 39: "If the limestone is in excess or readily attackable, the rapidity of the separation is so great that the proper pulp is forcibly projected outside the vessel." Now, you took a proportion of sulphuric acid which could not, by any possibility, have decomposed the limestone that you used, isn't that right?

A. That is correct; it could not have decomposed all of the limestone.

X-Q. 478. Froment gives a certain definite proportion of limestone, doesn't he?

A. He tells you one gram to every ten grams of ore, in the patent, and a few drops of sulphuric acid.

X-Q. 479. So he gives you a definite proportion of limestone, and as you read it, not enough sulphuric

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acid to decompose your limestone, and then he tells you that if the limestone is in excess you will get into trouble; isn't that what he says in his specification?

A. That is what he says here, yes; only I didn't get it.

X-Q. 480. When you made your determination with olive oil layers, what were the conditions as to the condition of the water and as to the times that you waited when you got your 9% for the thin layer of olive oil?

A. I took a test tube such as was shown here, of an internal diameter of one inch, and I made the first trial with water at 25° centigrade, which is room temperature, and I dropped the olive oil, without previous warming, at the present temperature also of the room, from a pipette, which was graduated in tenths of a c.c., so I could measure fractions. At .32 of a c.c., or a little over three-tenths, I looked at it from the side, as the test tube was held up, and that gave me very distinctly—more than a thin layer—what I would call a thick layer; but I looked at it from above, and I found that there was not a layer sufficient to cover the water. Therefore I passed on with the trial, and added additional olive oil until I reached .77, or rather more than two-thirds of a c.c., and the layer, which was quite perceptibly thick at the side, was still not in complete contact. I did not jockey it at all by shaking it to spread it out in contact, but I tested the matter fairly.

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X-Q. 481. You gave it a good deal of time, didn't you?

A. I went ahead as quickly as I could put it in, and I went on and added further oil, and at one c.c. of this olive oil, dropped in in the same way from above, and looked at, I had a complete covering for the water in this tube; in other words, the layer of oil completely touched the glass all around. Looked at from the side this was more than a thin layer; it was really a thick layer. One c.c. of the oil figures out 8.2% of oil reckoned on 10 grams of ore.

X-Q. 482. And that was the thinnest possible layer that you could get for a covering of the whole surface of the water, wasn't it?

A. At that temperature and in that experiment.

X-Q. 483. Now, you said in your testimony this morning that you had seen a machine made according to the Froment description operated so as to produce a froth. That is right, is it not?

A. In the Froment machine, that is right.

X-Q. 484. That is a machine made according to the Froment description?

A. Yes.

X-Q. 485. Where was that?

A. That was an experiment that was made in the trial at Wilmington, with the Froment machine, and is described in the exhibit book of that trial on page 838 of that exhibit book, volume 4 of the Miami case.

X-Q. 486. Do you remember what the recovery was of that operation?

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A. The total zinc extraction by weight was 72.39.

X-Q. 487. That was what you called the power driven Froment machine, wasn't it?

A. It is so called; it was the larger machine. There was a small Froment machine.

X-Q. 488. You had a hand machine there that was just like the Froment experimental apparatus, didn't you?

A. I believe there was also that there in court.

X-Q. 489. And that was operated and it produced a froth, didn't it?

A. I haven't found a record of that. A large number of results were given in what is called the report book, but what I have taken is just those that were accepted in court as shown in the so called assay book. I have seen the small Froment machine operated independent of that trial and assisted at the operation.

X-Q. 490. In the operation of that hand machine which was a reproduction of the Froment experimental apparatus, don't you remember that the first recovery was 2% and the second recovery was 6%?

A. I don't remember anything about it. I have not found the record of the results of the small machine.

X-Q. 491. Turn to exhibit record page 235, and there you will find the assays of those tests and the last one is the first Froment; and there you will find that the recovery as determined by the plaintiff's assayer was 1.95, and the recovery as determined by the defendant's assayer was 2.06?

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A. I would like to see that; I don't follow it.

X-Q. 492. Here is the page; volume 4. That is right, is it not?

A. I see the figures which you have quoted, but I don't find that; I don't think it is in my book.

X-Q. 493. This is the transcript—

A. I have found it.

MR. SCOTT: Why don't you ask the witness a question so we can all hear it?

MR. WILLIAMS: The witness was trying to find a reference in the book and I am trying to help him. Have you any objection to that?

MR. SCOTT: Well, let the witness find it.

X-Q. 494. Have you found in this book the figures to which I called your attention?

A. I have found the figures; I don't know to what they refer, because I can not sufficiently identify this experiment with anything which I ever saw. These figures appear in a summary of the assay of those tests. When those tests were made or where they were made or whether I was present, I don't know.

X-Q. 495. Now, if you will take the report book, you have it in your volume?

A. Yes.

X-Q. 496. And turn to page 38.

A. Report book, series C of Froment; here is the small Froment.

X-Q. 497. Now, that is the description of that experiment?

A. With the large Froment machine, yes.

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X-Q. 498. Aren't you able to identify what I have shown you as the assay of the result of that experiment; that was the first Froment experiment so described. And then, to refresh your memory still further, I will ask you to turn to Page 236, the next page after the one we had, and take the bottom experiment there, the second Froment series C, No. 6, and the other was series C, No. 6, and there the recovery according to our assay was 4.83, and according to the defendant's assay was 5.29. Don't you now recognize those as the results of that operation?

A. I did not see that operation that I know of. As I understand it, the experiments which were picked out from the assay book and shown to the court are those which were recorded later—picked out from the report book and shown were those enumerated later under the name of assay book, and I did not see all those experiments, and I am not able to say whether I saw either of these experiments with the Froment machine about which we have here the assay results.

X-Q. 499. Now, turn to the assay book page 889 and—

A. Well, I see that, and I see the last paragraph of that page also. We have here a report of two experiments, and the statement is made at the end: "These tests are for observation only in the production of mineral froth, and the apparatus was not designed or adapted for quantitative work, hence the recovery figures signify nothing."

X-Q. 500. How are those recoveries figured there. That is just an argument, and I want the facts.

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A. I don't know what they represent.

X-Q. 501. "The extraction, based on the weights and assays of the concentrates and tailings was 5.66%." That is the second experiment. That was on page 889?

A. That is what is stated.

X-Q. 502. And as to the first experiment, therefore, have you any statement as to what the extraction was. My statement was correct wasn't it?

A. Yes, and the explanation is given below.

X-Q. 503. Now, those experiments that are reported in that book were made in your presence, were they not?

A. If these were repeated in court, then I saw them.

X-Q. 504. And they would not be here in this assay book if they were not repeated in court, would they?

A. I guess that is right and proper.

X-Q. 505. Now, when you testified in the Miami case you had a theory in explanation of flotation did you not?

A. I had at that time stated that the simple selective action of the oil for the mineral as against gangue, and the adhesion of the oil to the mineral and the wetting of the gangue with water was not a broad enough statement, and therefore I discussed somewhat, as far as I knew it, the effect of surface tension. I was very much at a disadvantage in discussing that, for the reason that I am not a physical chemist, and I have never made any experimental

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studies or observation of surface tension phenomena, and therefore I only gave my view of the theory as representing the best information that I could obtain on the matter, and I recall that Dr. Liebmann coincided with my views in his similar expression, that it was the broader view of the phenomena, that is, that surface tension was an important feature in determining the question of froth formation. Further than that I did not go. I was in the dark as to the complete theory in the matter, and I remained in the dark until I heard the matter discussed within very recent time.

X-Q. 506. As you then explained the theory of flotation you regarded a reduction of surface tension as essential to flotation, did you not?

A. As essential to the concentration in the film and the development of increased viscosity in the film, which I stated I understood was a result of this lowering of the surface tension.

X-Q. 507. And I believe you very modestly said that you did not regard that as a complete explanation?

A. I certainly said so.

X-Q. 508. You are familiar, are you not, with patent No. 962678, to which you referred in your direct examination and which was put in evidence, that being known as the solution patent.

A. That was the second patent in suit in the previous trial?

X-Q. 509. Yes.

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A. Yes, I familiarized myself with this patent.

X-Q. 510. In fact you made a careful study of it and testified about it in the Miami suit; that is true, is it not?

A. I testified about it at that time.

X-Q. 511. And gave it careful study?

A. I did.

X-Q. 512. This patent discloses, does it not, a process of concentrating ores which consist in mixing the powdered ore with water containing in solution a small quantity of a mineral frothing agent; agitating the mixture to form a froth, and separating the froth?

A. That is stated in the claim to be the process.

X-Q. 513. That is disclosed in this patent, is it not?

A. Well, when you ask my opinion about that I can not answer that categorically, because I would have to refer to the fact that mixtures containing soluble portions which are in themselves frothing agents, are described, as already testified to; and when I analyzed this patent at Wilmington I referred to the prior reference to such soluble frothing agents in the Cattermole patent, cresol and phenol for instance.

X-Q. 514. I limited the question to what this long document disclosed, and I read the language to summarize it. That is my question; not whether it is the first disclosure or whether it is a proper claim, but whether or not what I read to you is disclosed in that patent.

MR. SCOTT: I object to that question your honor. It apparently has no relevancy in this case. It is ab-

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solutely incompetent as to what some patent means that we have neither set up in anticipation and which in fact is here and which is not involved in this suit.

THE COURT: Didn't you introduce this in his testimony in chief?

MR. SCOTT: Some slight reference was made to it for some purpose that I have forgotten.

THE COURT: At any rate, this man is an expert. It may even go to test his knowledge. I hope there will not be too much of it. The objection will be overruled.

A. I think this is disclosed as I stated it.

MR. WILLIAMS: If your honor please, I have a few notes which I can not put my hands on at the moment because the witness finished earlier than I thought he would^{and} I will finish up the cross examination very early in the morning.

Whereupon an adjournment was taken until tomorrow morning, Friday, May 4th, 1917, at 10 o'clock a. m.

Friday, May 4th, 1917, 10 A. M.

MR. KREMER: If your honor please, the order in connection with the filing of the amended and supplemental bill gave us—I think the order reads until Saturday in which to file the answer. I have the answer dictated, and it is practically completed; I think I will be able to file it today; however, I wanted to inquire as to whether or not the order included Sat-

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urday. I have engrossed or embodied the answer to all of the amendments to the complaint, so that there will be just one pleading in that respect and one pleading to the supplemental answer, so it really necessitated two pleadings.

THE COURT: Proceed with the examination.

DR. SADTLER,

CROSS-EXAMINATION resumed,

BY MR. WILLIAMS:

X-Q. 515. When was your attention first called to the California Journal of Technology; I mean, of course, the article therein which was introduced in evidence.

A. I think it was probably about the end of 1914, some months before the Miami trial.

X-Q. 516. Just before the Miami trial?

A. Not just before, but some months before.

X-Q. 517. You remember, of course, that it was called to the attention of the plaintiff just before the beginning of that trial, when we had all gathered at Wilmington and were ready to start with it; that was the first knowledge you had of it, at the time of the trial?

A. Well, that was not quite the first, because I had been told of it some little time before, and I went to the library in Philadelphia, of the Franklin Institute, and looked up the original Journal which was there on file, and I had photostadt copies made of it some little time before the trial.

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X-Q. 518. Now, comparing the Kirby process as you understand it with the Froment process as you understand it, they are essentially the same in their froth formations, are they not?

A. They involved in both cases the formation of an agitation froth by analogous devices. The conditions are considerably different in some respects. The Froment process, as carried out on the larger scale and as described in the Froment description, uses relatively small quantities of oil, as stated in the Froment description, 1% of oil for ore containing 5% of metal, 1½% of oil for ore containing 10% of metal and 2% of oil for ore containing 15% of metal. On the other hand, in the Kirby process we have a different kind of frothing agent, namely the light kerosene, or a solution of bitumen in kerosene, and it is used in a relatively much larger amount; but I find no difference in the result, looked at as a principle. In either case there is a complete froth formation, which froth becomes mineral-laden, whether the amount is 25 to 75% of Kirby or whether it is the smaller amount of Froment, and that takes place in the Froment procedure also in a so-called mixing device in which there is a centrifugal mixing device and from there it passes to the so-called coil-vat; in that respect there is a close analogy.

X-Q. 519. Now, comparing the Froment patent, British and Italian?

A. The Froment patent is a simple description of

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a principle illustrated by an example, and we have there nothing more than an illustration of the independent formation of an air froth by agitation, aided in this case by the presence of the carbon dioxide which is evolved in whatever degree it may be, due to the reaction of the sulphuric acid and the calcite. But the Froment example and the phenomena observed by Froment, and made the basis of his patent, are simply illustrations of the principles and the broad results which follow. We have to turn to the Froment description, of course, for working apparatus, if that is desired.

X-Q. 520. According to the Froment principles, as you understand them, the froth is composed of air bubbles with a coating of sulphide or metalliferous mineral. That is right?

A. Mineral and mixed gases.

X-Q. 521. And according to the Kirby process as you understand the froth is composed of air bubbles with a ~~bubble~~^{coating} of metalliferous minerals?

A. I think so. I so conceive it.

X-Q. 522. Well, that is true.

A. I do so conceive it to be true, yes. That is what I meant to have said.

X-Q. 523. Now, will you turn to the file, wrapper and contents of the Kirby patent, Hyde record, defendant's record page 517 and at the top of page 517 you note that the claim 2 was rejected by the patent office on Elmore, Sulman and the British patent 12,778 to Lake?

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A. Claim 3 you speak of?

X-Q. 524. Claim 2? That is true, is it not?

A. The claim 2 which was rejected, does not speak—

X-Q. 525. Just answer the question, please?

A. Claim 2 was rejected by the patent office in view of those patents named by you.

X-Q. 526. And one of these is the Froment British patent?

A. That is true.

X-Q. 527. Now, claim 2 which was rejected appears at page 510 and is as follows: "The process of separating minerals, which consists in mixing together pulverized mineral material, a considerable quantity of water and a substance ⁱⁿ ~~im~~ ^{is} ~~in~~ miscible in water but of less specific gravity, and which, in the presence of water, will adhere to some of the mineral particles and not to others; in gently agitating the mass and blowing into the same a gas to assist the flotation of said immiscible substance and the mineral particles which have become coated therewith; in removing the floating layer and separating said adhering substances from said mineral particles, substantially as specified." That is right, is it not?

A. That is a correct reading, yes, sir.

X-Q. 528. Now, we will turn to page 526, and there we find, do we not, the arguments that were submitted on behalf of the applicant as to the rejection of that claim 2 on the Froment and other patents? That is right?

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A. There is an argument here and I am just beginning to read the portion—

X-Q. 529. Now, I will read a part in that argument, commencing about the middle of page 520: "Lake's process"—that is the Froment British patent, is it not?

A. That refers to the British patent agent, I have no doubt.

X-Q. 530. And in whose name the Froment patent was issued?

A. Yes, sir.

X-Q. 531. "Lake's process is for a specifically different thing, and does not tell the public anything about the advantage of gently agitating a mixture of water and mineral particles coated with an immiscible liquid and assisting their separation by blowing in air." Now, I will say here that there are some typographical errors in the print which will appear upon a comparison with the original file wrapper and contents and I am reading it with the corrections. "Lake discovered that gas bubbles liberated in mineral which he describes become coated with chalcopyrite dust. This discovery is absolutely without value in the applicant's process since the mineral particles are already coated with bitumen, and the problem presented is one of separating the bitumen from the water." Do you agree with the statement made on behalf of Kirby in the prosecution of his application for a patent, that the discovery that gas bubbles become coated with a dust

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of metalliferous mineral is absolutely without value in the Kirby process?

A. No, I do not agree with that. I agree with the first part of what you read that the Lake process is for a different process from gently agitating. I agree with that, and I do not agree with the idea that gas bubbles in the Kirby process may be coated with chalcopryite dust, as it is termed, simply because we have the several elements in the separated froth. We have the coating that he speaks of with bitumen, but that Litumin is a solution in the thin kerosene and constitutes the oil film. Now the oil film concentrates in itself the chalcopryite dust or the other mineral particles and we can have the coating which is referred to here by the attorney for Kirby, and we can also have the separating in that film of the mineral particles, and do have it.

X-Q. 532. You do not agree there with the statement?

A. I do not agree with the statement as it is given here without qualification.

ing some gas coated with metalliferous particles are

X-Q. 533. And you believe that bubbles contain-
clearly disclosed in the Kirby patent? That is what
you believe?

A. That bubbles coated with oil films of the character of the oil used by Kirby, that take up the load of metalliferous mineral, and that forms the strong coating of the bubble and enables it to give us the concentration.

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X-Q. 534. Doctor, turn to page 510. I will read to you claim 1 of Kirby.

"The process of separating minerals, which consists in the mixing together (a) pulverized mineral material (b) a considerable quantity of water (c) a substance immiscible in water, but of less specific gravity, but which, in the presence of water will adhere to some of the mineral particles and not to others; in removing from the surface of the mass the floating immiscible substance and the mineral particles to which it is adhered; in the filtering the material so removed, and in distilling the filtrate to drive off and recover such immiscible substance, substantially as specified." Do you agree with that statement of Kirby's invention as he originally filed it in the Patent Office?

A. That is a distinctly different statement, less complete than now appears in the first claim of Kirby's patent as issued. At the same time I call your attention to the fact that what is here stated allows our understanding of a froth formation and float, for the reason that we have in here these words, "in removing from the surface of the mass the floating immiscible substance and the mineral particles to which it has adhered." Now, it was quite conceded in the course of the discussion of the Elmore patent that the Elmore separation of the mineral particles did not take place in the surface of the Elmore oil layer. Here we have the separation of the floating immiscible sub-

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stance and the mineral particles ~~form~~^{form} the surface of the mass, which means a froth; but it was more elaborated and more clearly stated in the final form in which the Kirby patent was issued.

X-Q. 535. Isn't it an essential feature of every process wherein they float the metalliferous particles to the surface that they separate that float in order to get the mineral particles away from the gangue which is in the pulp?

A. Of course you separate the mineral particles that have been taken into the oil, but there are two conditions existing; the one case in which the float in the form of a froth is on the surface of the oil, and the other case as in the Elmore process, where it is carried by buoyancy throughout the oil layer, and the separation takes place, not from the surface, but takes place by means which have been described in the California Journal of Technology, by centrifugal or other means of that type, in which they get a perfect separation of the whole mass of the oil layer with the mineral.

X-Q. 536. I will read the question. (Last question read.)

A. I can answer yes, to that.

X-Q. 537. And isn't it a very good description of that operation, if we say "removing from the surface of the mass the floating immiscible substance and the mineral particles to which it has adhered."?

A. It is a good description if we apply it to the

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removal of the froth. It is not a good description if we apply it to the separation involved in the Elmore process.

X-Q. 538. The Elmore process, does not the floating layer of oil carrying mineral particles overflow so that by that overflow it is removed from the surface of the mass of the pulp; answer directly, please.

A. They are carried undoubtedly in the oil layer, but not on the surface.

X-Q. 539. Isn't the oil layer carried on the surface of the pulp until it is overflowed or removed from the surface of the pulp?

A. Yes, it is

X-Q. 540. Now, in the Froment description at page 733, of complainant's record, Volume 3, in the Hyde case—

A. I have the whole translation of Froment here, although I do not follow your paging.

MR. SCOTT: I will give it to you Doctor. Here is page 733.

X-Q. 541. Under the heading "Instructions," is it not stated that "in order to arrive at a perfect disintegration of the constituent particles of the ore, without rendering it impalpable, it is necessary to do the crushing in two operations," and is it not further stated that "on leaving the second crushing mill, the ore will further be submitted to two or three spitzkastens for eliminating the slimes, which is too fine to be treated, and which could not be treated by any hitherto known

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method.” That is the statement of Froment’s description, is it not?

A. That is the statement.

X-Q. 542. And that is an instruction, is it not, to deslime the material that is treated?

A. That is what it practically amounts to.

X-Q. 543. And in all these experiments which you have referred to or which were conducted at the Miami trial, it is true, that the ore was not de-slimed, and you so admitted, did you not?

A. I don’t recall the condition of the ore when we used the Froment apparatus, large or small machine. There is no such limitation, of course, in the Froment patents, Italian or British.

X-Q. 544. I did not ask you that; please confine yourself to the question.

A. I don’t recall in regard to the separation of the ore for the Froment machine, because I had nothing to do with the preparation of the ore.

X-Q. 545. You don’t remember that you admitted that that ore was not deslimed?

A. I don’t remember that I admitted it, because I had nothing to do with the preparation of it. If I did admit it, it was because I was told so by hearsay.

X-Q. 546. Is there in the Froment patents Italian or British, any mention of the use of heat or of heating the pulp; answer directly, please.

A. I believe not.

X-Q. 547. You know there is not?

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A. I don't remember—Yes, I know there is not any mention of the matter of temperature.

X-Q. 548. Now, we will turn to the record in the Miami case, Volume 2, page 1004. To make the matter as short as possible, it appears on the preceding page and on this page, does it not, that you summed up the question of the bearing of surface tension on ore concentration and stated three cases were to be considered; first, the normal surface tension of the water; second, where the surface tension of the water was raised, and third, where the surface tension of the water was lowered. That is true, is it not?

A. That is the classification under the head of the bearing of surface tension on ore concentration; there were three cases, as you stated.

X-Q. 549. Now, I will read to you what you said about the third case, from page 1004: "Now, third. In the third case the surface tension of the water may be lowered by dissolving certain organic compounds or contaminating or so called modifying agents. This third class includes all agitation and aeration processes which are dependent upon frothing or bubble formation, whereby the buoyancy of the air becomes effective for raising minerals. And as I have already indicated in the matter which I read, this would include the effect of emulsifying^{ed} ~~ing~~ oil in lowering the surface tension either by soluble or insoluble contaminating agents—lowering the surface tension and thereby facilitating froth rising." I have read your evidence correctly, have I not?

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A. Yes, sir.

X-Q. 550. Now we will turn to page 1162, and I will start with X-Q. 1238. "Q. What is your idea of what an oil froth is—I don't quite understand it.

A. The word is used a little indiscriminately. Sometimes the oil emulsion is called oil froth, because sometimes an emulsified effect is sometimes referred to as froth, but as the word froth is more particularly used in reference to these processes, I must differentiate between oil emulsion and oil formed froth, which I am trying to do. X-Q. 1239. What is oil emulsion?

A. It is an emulsified mixture of oil and some aqueous liquid, in which the air plays a very secondary effect.

X-Q. 1240. What are the bubbles made of—They are air? A. Probably air." I have correctly read your testimony, have I not?

A. You have.

X-Q. 551. We will turn to page 1170: "X-Q. 1304. Do you put forward, as an explanation of the phenomenon of a mineral froth produced by agitation or produced, as you have said, the doctrine of surface tension as a complete explanation of the phenomenon?

A. It explains the case of soluble agents, as probably the only scientific explanation, because we can not assume there that those dilute solutions of the frothing agent have the selective coating action which is ascribed to oil. It can also be made to cover the case of oil used in small quantities, because by the use of oil in small quantities, we have present the emulsification of the oil, and the oil emulsion there acts distinctly in

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the way of lowering surface tension, as is stated by these authorities which I have quoted. So that it is broad enough to cover both oil used in small amount and the use of soluble frothing agents, and it makes unnecessary to dwell particularly upon the selective action of oil, which of course exists for mineral particles." Have I correctly read your testimony?

A. You have correctly read what I said at that time.

X-Q. 552. We will turn to page 1181, commencing with R-Q. 1365. "Q. Upon your previous examination you discussed the theories underlying the formation of froth, and referred to the early theory of the selective affinity of oil, and then went on to say: 'I am inclined to believe that at the present time the general view is that with the flotation processes which use small quantities of oil there is a broader explanation.' I want to ask you whether that broader explanation is confined to the use of small quantities of oil, or includes all cases in which a froth is formed; that is, by a small quantity of oil, referring to that term in the sense in which it is used in Patent 835120.

A. I had in mind there the thought that particularly when small quantities of oil would be used, that the oil would be easily emulsified, and we would then have that condition of oil emulsion which it is stated has the same influence in the way of lowering surface tension that the soluble frothing agent has, or soluble contaminating agent. But if the oil be in somewhat larger amount, it is only a question of its

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emulsification. A portion of it is always emulsified with the energetic agitation which is carried out in these processes for air froth raising. The presence of a trifling amount of unemulsified oil would not interfere, as I could see, with that way of operating, and I think that, until the oil amounts to a considerable amount, that it will be emulsified sooner or later in the continuance of that first stage of operation; that is, the agitation; and there will be enough of it emulsified very promptly to make it possible to include it in this explanation, or this underlying theory that I spoke of." Have I correctly read your testimony?

A. You have correctly read what I said.

X-Q. 553. Now, we will turn to page 1331, commencing with Q. 34a. "Now, Doctor, I think if you will take the rest of the session and describe the operations which were performed and the results, it will assist in understanding this matter. A. In this last experiment, the oil taken was chosen so as to typify the thick viscous oil of the Elmore process, but taken in the amount of 25% which is utterly inadequate to effect the desired flotation by the buoyancy effect alone, which has been stated by witnesses repeatedly, requires the use of 100 volumes, or 100% to realize the bulk oil flotation. Nevertheless, this was given careful and slow rotation, which would correspond to the Elmore mixing treatment, and we then examined the oil layer, and it was found to be broken, and the oil globules had dropped out because of the overloading with mineral, and quite an amount of these oil

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globules gathered below. The mixture, after a short time for observation, was then shaken vigorously for a few minutes, and we then had an air froth formed, although the air froth did not illustrate a very perfect separation, because of the character of the oil and the large amount. Q. 34 b. The residuum oil—Is that suitable for the formation of an air froth, a mineralized air froth? A. No, sir, it is not.” Have I correctly read your testimony?

A. You have.

X-Q. 554. We will turn now to page 2085, which is in volume 3 and I will commence with the answer to question 29, with the general statement that the—well, I will commence with the question so as to make it clear: “In scenes 20 to 44, a series of pictures was projected, showing the current of air bubbles, passing through a water clear, and water modified with different reagents—different substances.

What comments do you have to make upon the experiments shown in those pictures?

“A. These were very interesting illustrations, and, essentially, they illustrated very well what already had been shown in the circular aeration cell which I have shown in my testimony. We found the same thing practically by modifying water, first starting with pure water and seeing the formation of air bubbles in pure water, and then adding a single drop of crepsol, and seeing the effect of that, producing the breaking up of the larger bubbles into fine air bubbles, a condition that forms, momentarily, the ^{whit}~~black~~ish layer of finely

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divided air bubbles due to the modifying of the cresol.

The pictures of Dr. Grosvenor show the matter very clearly and suitably, and better perhaps than the single operation, because it was possible to follow the condition and compare more graphically, I should say, this condition than by watching the single experiment. I have to say, generally, I agree entirely with the statement:

‘Agitation of water unmodified by a mineral frothing agent produces air bubbles which coalesce, rise and burst. Mineral frothing agents produce small and persistent air bubbles.’

“I believe that is well known.” Have I correctly read your testimony?

A. You have. I would like to say that the text is hardly accurate there. Referring to the pictures of Dr. Grosvenor, the expression is: “Due to the modification of the cresol.” It should be due to the modifying effects of the cresol, but you have given it correctly as it appears here.

X-Q. 555. Now, page 2092, commencing in the second paragraph of the answer to question 45: “Now we had two experiments, of which the second one only need to be carried out, using light pine oil which is insoluble oil, and will be taken in the amount of three per cent, reckoned on the water taken. With that we had meant to compare the effect of .1 per cent. What will be produced here will be an oil emulsion, or rather, an emulsified oil, I would prefer to call it.

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which is a froth raising agent." Then, passing down to question 46, thereby omitting the statements of counsel: "Are you going to do the experiment first with the small or with the large quantity of oil? A. First with the small quantity. We have here the effect of a modifying agent, although not a soluble modifying agent. Emulsified pine oil has the same effect of lowering the surface tension, which is the end to be achieved by the soluble frothing agent, and the froth produced may be a little more lasting. (The experiment referred to was performed). This is with an insoluble agent." Have I correctly read your testimony?

A. That is correctly read, and it is what I said then. I thought so then.

X-Q. 556. Continuing on page 2093, question 49: "In connection with scenes 46 and 47, Doctor Sadtler, I notice that Dr. Grosvenor prefaces his remarks by the statement: 'Practical results—air bubbles produced in modified water pick out metallic particles and reject gangue particles', which statement he discusses in the following part of his testimony. Are you in agreement with the ^{conclusions} ~~conditions~~ there drawn? A. I think this is correctly stated.

X-Q. 557: "Q. What relation has this phenomenon to flotation concentration generally?

"A. This is, as stated, an expression of practical results, and I think it is undoubtedly true that flotation phenomena are those produced by the air bubbles, and the qualified expression, 'in modified water' covers a

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number of cases in which the water is modified, either by the presence of emulsified oil or by the presence of soluble frothing agents, both of which have a general effect of modifying the water and making it possible to obtain more permanent subdivision of air bubbles, which facilitates, and is the underlying explanation of the reason of the mineral froth." Have I correctly read your testimony?

A. You have.

X-Q. 558. Now, we will turn to page 2099 and I will commence to read in your answer to question 71: "The air froths undoubtedly consists of metallic particles which are held and brought up to the surface of the froth by the action of air bubbles, and it is the air bubbles which attach.

"Now, we have a demonstration in those experiments in the glass cell, that the air bubble attaches equally to the unoiled and to the oiled particles of mineral sulphide, so the direct attachment is to be obtained in the application to oiled or unoiled particles. It is not confined to the unoiled particles. It is true there is no entrainment of oil. It is true, but the presence of oil is none the less to be shown, and has been shown in these experiments, which were made in the glass jar, and that is practically allowed for in the last sentence of this statement: 'Fundamental principles air entrainment and controlled affinity of air for metallic particles in presence of frothing agents.' That 'controlled affinity of air' will cover the case of air froth in which notable quantities of oil are used, because it is the pres-

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ence of the emulsified oil which makes possible, as the modifying agent, that air rising, and not only is that true, but I am satisfied that the presence of oil in the large number of these air flotation processes operates not only to make an emulsion, which makes lower surface tension, but operates in minute amount in oiling the mineral particles, and that the raising of the air bubble is the raising of the oiled mineral particle." Have I correctly read your testimony?

A. You have correctly read what I said at that time.

X-Q. 559. You remember, do you not, that during the Miami trial an experiment was made in behalf of the plaintiff using one tenth of one per cent of oleic acid and producing a fine mineral froth and then 3.6 per cent of oleic acid was added, the operation repeated, and everything sank to the bottom. You remember that experiment?

A. What was the latter part of your statement?

X-Q. 560. 3.6 per cent of oleic acid was added to the pulp, the operation was repeated ~~and~~ ^{can} agitated for five minutes, and at the conclusion of that operation when the material came to rest, everything went to the bottom. Do you remember that?

A. I don't recall the details.

X-Q. 561. You don't remember that experiment?

A. I don't remember the experiment now. I would not feel sure that I remember at all that that was done. It may have been true, however, that that was done. I don't recall it.

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X-Q. 562. Now we will turn to the Everson patent, page 607 of the Hyde record and to page 2 of the Everson patent and I call your attention particularly to the sentence beginning on line 105: "Devices and methods now well known in the ~~water~~^{wet} separation of ores will be suited to this part of the operation, bearing in mind that the sand and mineral are merely transposed or their relative positions are reversed, because the sand is heavier than the mixture of mineral, oil and acid." Then the following sentence: "A proper selection of devices for this purpose will be apparent to those skilled in the ~~water~~^{wet} separation of ores." Now, do you know what devices were referred to by Mrs. Everson in this patent of her^s issued in 1886 as "devices well known" in the United States in the wet separation of ores? Answer directly?

A. Speaking from general knowledge which I acquired of this matter I would say the spitzkasten was perfectly well known. I am not a metallurgical engineer and I might possibly be more specific in my statements had I knowledge acquired from study of the literature on ore dressing; but the spitzkasten was perfectly well known as has been shown by the testimony introduced, that it was known and known by name prior to 1885; and this description here fits perfectly with the possible use of a spitzkasten. So that if it was well known, we have there undoubtedly a form of apparatus which would do exactly what was desired here, carry off the float, leaving the sand separated. And this particular note of Mrs. Everson's,

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"bearing in mind that the sand and mineral are merely transposed or the relative positions are reversed, because the sand is heavier than the mixture of oil, ore and acid." That fits perfectly with the use of a spitzkasten. The sand is settled down, is taken off at the bottom and the froth, composed of these ingredients, that is the mineral and oil in presence of acid, by agitation worked into a froth, is carried off, floated off.

X-Q. 563. Do you know that any such procedure would be in accordance with the established principles and methods of wet concentration as carried on in 1896?

A. I do not know it in a professional sense because I have no knowledge that is at all accurate of metallurgical practice.

X-Q. 564. Now, returning to the Miami record, to refresh your recollection as to that experiment, which you did not remember, turning to page 2130—

A. Of what volume?

X-Q. 565. Volume 3. I will ask you to look at the details of that experiment entitled "Second experiment, showing air bubble rejection of well oiled particles"?

MR. SCOTT: What is the question? Is there a question on the record?

MR. WILLIAMS: I wanted to give the doctor a chance to read that before I finished the question.

X-Q. 566. Have you examined the description of that experiment?

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A. I have.

X-Q. 567. Isn't that the experiment to which I referred?

A. That is the experiment evidently to which you referred. I have no recollection at the present time of the conditions of the manipulation. I undoubtedly was present in court but I do not recall the conditions of the manipulation and I cannot pass a critical judgment on the result without that illustration of the condition of agitation and other processes.

X-Q. 568. The experiment was made in your presence?

A. I presume it was but I do not recall it.

MR. WILLIAMS: Cross examination closed.

RE-DIRECT EXAMINATION,

BY MR. SCOTT:

R-Q. 569. Doctor, you referred to the passage at page 1081 of the Miami record, volume 2, the passage which was read to you, and I will ask you if you have any desire to make any comment upon the statements you there made?

A. I said at the time of the Wilmington trial in answer to cross question 671, the question being: "And is not associated with directons representing any definite mechanical structure? A. There are none." I would like to say now that I did not do justice at that time to the Fryer Hill publication. The Fryer Hill publication, if studied very carefully, and it has been

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illustrated here of course by the apparatus, and I would like to say now that there are very definite directions with regard to the mechanical structure. In other words, the whole story which we find in the Fryer Hill publication in regard to the circular tank, or receiver, the rotating, hollow tube, the bottom of which tube having attached to it a couple of fans and the whole operation of this, the semicircular doors which are attached, hanging vertically at the beginning, afterwards raised, shows quite a definite statement of mechanical structure. In other words, the mechanical structure was quite sufficient and complete there to allow the reproduction of the Fryer Hill device; and that has been reproduced and operated, based entirely upon that information.

R-Q. 570. A passage was read to you from your testimony in the Miami case occurring on pages 1059 and 1060, and in that connection will you state whether Everson disclosed more than one method of concentrating ores?

A. This method which is under discussion and consideration, to which the questions and answers were given on page 1059, had entire reference in that first instance or first illustration of Everson with regard to the mixing of acid with oil and then after that mixture had been made completely, working up the ore—that mixture had been made complete, working up the ore; and that was specified to be a process of washing out the gangue; and the quantities there

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given show that it was a process for eliminating the gangue and leaving in a pasty mass the supported mineral. That process I have characterized in my testimony in this case as a different process from the froth raising process and not involving froth raising. And I have illustrated in this case the second form or second process of Everson in which petroleum or a petroleum particle was used, and in which the Fryer Hill apparatus was made use of and also the cataract machine was availed of to illustrate the second step of the Everson process, quite different. And in the beginning of my testimony in this trial I endeavored to classify the processes of operation and in that classification I put the first instances of Everson and second instance of Everson in totally different categories.

R-Q. § 71. A passage was read from your testimony in the *Minerals Separation v. Miami*, the passage relating to the Criley and Everson publication which appears on page 1083, volume 2, of the record in this case. In connection therewith I would ask you what if any inference you draw or obtain to base upon the use of the word "scum" in that Criley and Everson publication?

A. The Criley and Everson publication, as I have also in connection with testimony in this case mentioned, contribute only a picture of results of the account given in the Fryer Hill publication. That picture of result is—or rather it contributes merely a picture of result with continuous methods because it gives so little account of the general sequence of steps.

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But then, it says, "This acidulated water was then mixed with the mass of oil and ore. A thick scum of sulphurets rose to the surface and was skimmed off leaving the hitherto black ore as white as snow." I have heretofore illustrated that the word "scum" was synonymous with "froth" and I have also drawn attention several times to the fact that the words "froth" and "scum" are constantly used as synonymous in the literature of these patents, and particularly in the patents of the plaintiffs.

P-Q. 572. You have referred to the use in the Kirby patent of a solution of bitum^en and kerosene. Does Kirby refer to the use of anything else besides this mixture?

A. Yes. In Kirby's patent we have the statement on page 2 of the patent: "Kerosene alone, for example, may be used with most ores to take out the sulphides, provided the gas is used as stated to cause the flotation of the kerosene particle." That means that you can use kerosene if you supplement it with the use of a gas as is described by him in detail here on the page preceding; but, on the other hand, he says it is the bitum^en which, dissolved in the kerosene, gives the decided adhesion to enable him to separate the pulverized chalcopryite. And therefore, as I understand it, he meant to say that if this bitumen in small amount is dissolved in kerosene you have a distinctly more efficient frothing agent and selective agent, if it can be called; but if you supplement the use of kerosene taken alone by the use of a gas as in the second step, you

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need not use the bitumen, you can use the kerosene without dissolving the bitumen. I have tried both ways. I have used kerosene repeatedly in the Kirby experiment and I have used a certain Trinidad asphalt, a type of bitumen, in the amount there mentioned, five per cent with kerosene, and attained results in both cases.

R-Q. 573. A number of passages in your testimony in the case of Minerals Separation vs. Miami were read to you. Do you desire to comment upon any of the matters there presented? The first one was on page 1170, X-Q. 1104. Was there any explanation or comment you wish to make? If so, you will be given an opportunity to discuss it if you want to?

A. I do not care to go into the details of the question about the surface tension. I would merely say that what I stated there is very much less of an explanation—a very much less perfect understanding of the physical phenomena than we have arrived at now. Undoubtedly the effect of surface tension exactly as stated there exists, but the way in which lowering of surface tension is followed by the strengthening of the film once produced by the increased viscosity given to it under the conditions of practical working has been more fully developed since the date of that Miami trial; and ^{and} ~~any~~ explanation given there I would not consider as at all a full explanation of the theory. The theory has been dealt with very fully in this trial and I have a clearer view now of what takes place in the formation of a mineralized air froth than I had

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then, although I do not feel that I made a gross misstatement at that time.

R-Q. 574. You have heard the testimony given about the operations of various firms using quantities of oil ranging upward—I think the highest so far was the Arthur plant of the Utah Copper Company where something like 86 pounds of new oil were added per ton of ore. Will you compare such operations with the processes described in the Everson patent and the Kirby patent and the California Journal of Technology?

A. These processes involve as the same step mentioned in all of these publications, the thorough agitation. Now, the thorough agitation is one very deciding element in the determination as to the amount of oil used in an operation. In other words, the necessary amount of oil to produce a mineral-coated froth is a function of several elements, one of which is this agitation. Agitation being one; the richness in mineral sulphides being another; and the dilution of pulp being the third. Particularly in the case of—particularly on the question of agitation I would like to say that if we provide sufficient agitation the large amount of oil can be entirely handled, entirely brought into the condition of a coating film of the additional air bubble supply, and that oil coated film then, as the next step, condenses on its surface the mineral sulphides, strengthening the film, making it more stable because of the increased viscosity. And this takes place with the small amount of oil or with the large amount of oil, the main deciding function (factor) there being in-

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creased agitation. So that, in principle, it is not different from what was done with 17 per cent of oil in Everson or with the nine per cent of oil I tried in the Froment test tube experiment, or with the smaller amount of oil used in the Froment machine or with the 25 per cent of oil used in the Kirby. In all cases, if we provided the agitation, we accomplished the production of the oiled ^{air} bubbles which constitute the froth. These, as I say in turn are stabilized and give us the mineralized froth, which is the new product in all cases.

R-Q. 575. It has been testified, as I think you remember, that the agitation was not at all altered when these large quantities of oil were used. How do you explain that?

A. The agitation is quite abundant in all of the operations that I have seen here to accomplish the formation of a froth which takes up all of the oil in the form of oil film, and I don't know in what degree agitation is controlled or modified to respond to different amounts of oil in large practice; but as far as I have seen illustrated in the illustrating experiments there was no difficulty at all in handling 25%—the 25% of Kirby or the amounts that were used in the Everson with the ordinary agitation there shown.

R-Q. 576. Did you see the experiment performed by Mr. Dosenbach in which he used something over 1% of oil and agitated the mixture and formed a froth, and then agitated again and caused the mineral to sink—to break up the froth, and after doing that

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two or three times, finally sank the mineral and separated it as the Cattermole granules in an up-cast?

A. I saw that experiment and watched it very closely, and I have given quite a little consideration to what has been done there and what the results are and I think it is an extremely instructive experiment. I think it is an experiment that goes very clearly right to the heart of the questions which are involved in these patents, and particularly in No. 835120. The first was to use $1\frac{1}{2}\%$ of oil, as the statement was made at the time, and the vigorous agitation in the Gabbett cone mixer, using the baffles, too, in the circular cells, and that the speed of revolution was 1450 revolutions, as stated by Mr. Dosenbach at the time. That produced in six minutes' agitation, which was carried on with this rotation of 1450 revolutions—That produced an excellent mineral froth, which was allowed to come to rest and examined. Then, with that froth in which the oil was completely taken up with the oil film of the air bubbles, and which had been accomplished by the entraining of air,—and as this rapid agitation has been frequently described, by the beating in of air, so that it was subdivided minutely, and these minute air bubbles were coated by reason of this agitation with the oil, and they had taken up the mineral and caused an excellent mineral-coated froth, which was quite recognizable as such. Now, the sole step which was taken next was to change the speed of rotation. The baffles were not taken out in this case; it was found that leaving the baffles in and

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merely modifying the rotation so that we had a different style of agitation, an agitation at 300 r.p.m.—I watched it very closely—and that style of rotation had the effect of discharging and eliminating the air which formed the froth from its combination with the oil and the mineral. Now, that agitation continued for six minutes, and at the end of that slow ^{rotation} ~~agitation~~, and the baffles acting less clearly and less sharply, because of this slow rotation, they did not disturb the rotating mass very greatly—at the end of that period of rotation the contents of the cylinder were allowed to come to rest, and we observed no froth on the top, but on the contrary, the oil set free from its contact with the air, and the mineral set free from its contact with the air, had agglutinated and formed the sinking agglutinated mass of sinking mineral, which is pronounced the Cattermole effect. Next the speed was brought back again to 1450 revolutions by changing the connection, and it was agitated for one minute. That one minute of supplementary agitation again reproduced the froth, because that agitation at the high speed again entrained the air and subdivided it finely and allowed the oil to spread itself in the air film again and to pick up the concentrate mineral, producing the mineralized air froth. I should say that that was again changed, and rotated at 300 revolutions, and granules were formed, and they were taken off finally, five minutes being used for the second slow agitation. I think this experiment is extremely illuminating, because it shows that the production of the mineralized

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air froth and the production of the Cattermole granules, using the same amount of oil, the same vessel, everything being absolutely the same, with the sole difference of the type of agitation, is the key to the situation, and that the statements, therefore, in patent 335120 in regard to the new phenomena produced by lowering the percentage of oil relative to ore—I think are based on false reasoning. I think it has been built up there on mistaken premises, and I think this experiment, if studied carefully, shows that fact.

RE-CROSS EXAMINATION,

BY MR. WILLIAMS:

RX-Q. 577. I understand from the evidence that you have just given that you adopt these large scale operations which have been testified to at the Butte & Superior plant, the Chino, the Ray, the Utah Copper Company Arthur plant and the Utah Copper Company Magna plant as representing the prior art. Is that correct?

A. They are entirely in consonance with the prior art, with mechanical improvements, but no new principle added.

RX-Q. 578. And what prior art do they represent?

A. The prior art developed by Everson, Froment, and Kirby.

RX-Q. 579. And which is represented by the operations of the Butte & Superior Copper Company?

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A. There is no new principle, other than that which was already developed by the Everson second process, with some additional light thrown upon it, but no new principle added, by the Froment. I should say that the Everson alone gives all the principles involved in the present application.

RX-Q. 580. But I am concerned, not with principles, but with operations. What prior art patent is represented by the operations of the Butte & Superior mill which have been described in the evidence, with twenty and a trifle more pounds of oil to the ton of ore, carried on in the Janney machines?

A. There has been no description of the Janney machine in the prior art, that is true. There has been no description of the various mechanical appliances, but the principles of the process which is there applied by improved mechanical devices, has all been disclosed in the Everson patent.

RX-Q. 581. But these operations of the Butte & Superior mill with one per cent and a trifle over one per cent of oil, what prior art do they represent?

A. Everson and Froment.

RX-Q. 582. Everson and Froment?

A. Yes, sir.

RX-Q. 583. How do they repeat Froment?

A. Froment used small quantities of oil as described in his description, one per cent and two to two and a half.

RX-Q. 584. We will take the Froment patents. Do the Froment patents describe 1% of oil?

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A. No.

RX-Q. 585. We will take the Everson patent.

Does the Everson patent describe one per cent of oil?

A. It does not describe any per cent. It gives an example, which, reckoned out, makes 17%, but it does not describe any per cent.

RX-Q. 586. So that it only describes an operation with 17% of oil?

A. That is the only example.

RX-Q. 587. Now, we will take the operations of the Utah Copper Company Arthur plant with one per cent of oil and a trifle over. What prior disclosures are reproduced in those operations?

A. I have the same answer as with regard to the Butte & Superior, which you spoke of. We have the principle already stated which is involved there, with mechanical improvements, and the per cent of oil is not limited in that statement of the principle in Everson.

RX-Q. 588. Then you stand upon them as representatives of the Everson, reproductions of the Everson?

A. With the mechanical improvements and the experience gained by the working out of those principles.

RX-Q. 589. With improvements and knowledge and experience which have followed the introduction in this country of the process of the patent in suit, isn't that right?

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A. Yes; there has been an immense mass of experimental work done in all the mills, which contribute to it.

RX-Q. 590. And as to the other plants, the Chino and the Ray, I presume the same thing applies?

A. The same would apply.

RE-DIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 591. As regards all of these plants just referred to on cross examination, the Butte & Superior, the Arthur, Magna, Chino, Ray, which have been operating with quantities of oil upwards of one per cent., I would ask you, considering this as a process, as the application of principle regardless of the particular forms of the mechanism used, whether or not you find any principle or operation in practice in these mills which is not set forth in the Everson patent, the Froment British and Italian patents, and the Kirby patent, and the articles in the California Journal of Technology?

MR. GARRISON: I object to the form of the question; it is entirely improper to ask an expert such a question.

MR. SCOTT: The question merely calls for whether he finds in these operations the application of principle not disclosed in this various literature. The question was objected to as improper, but there is no

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reason given. That is all I can say to the objection in that form.

MR. GARRISON: I think it is obvious, if the court will indulge me. The counsel has simply formulated what he desires to have testified and the witness was left simply to say yes or no. It was entirely the evidence of counsel.

THE COURT: Objection sustained; you can change the form of the question.

MR. SCOTT: Do I understand the objection to be that the question is leading?

THE COURT: I think it is leading; that is to say, it is your statement to which he is to give a yes or no answer, merely to assent or dissent from your statement.

Defendant excepted.

R-Q. 592. State, Doctor Sadtler, what you consider the essential steps and the essential ingredients used in the process as practised by these various mills named in my previous question—what you consider the essential operations and the essential substances used.

A. The essential conditions of the illustration of the principles which have been given in the prior art are, the presence of the finely ground ore with the addition of a sufficient amount of water to make a freely flowing ore pulp, and the addition of oil which oil has a selective action, as defined, a large number of which are enumerated by Everson; and then thorough agitation, which will bring about a commingling

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of these ingredients. Under those conditions we have, following the laws of physics, certain results, which results are first, the formation of fine divided air bubbles coated by the oil film, and it has been shown that that amount of oil may vary over wide limits; those oil coated bubbles have the power of condensing into their film metallic sulphides, mineral particles of that type, and of rejecting the gangue material, and the agitation provides the conditions for a separation, by reason of the formation of this mineral coated froth, which, flowing into the spitzkasten will separate, and is then by mechanical means ~~is~~ taken out and afterwards treated. The tailings can be retreated, which is already indicated in the early literature; retreatment is spoken of in that California publication, and also in the others, and therefore we have all the conditions pointed out for following a successful operation in practice. Many mechanical devices had to be introduced, and very considerable experience had to be gained as to how it would work to the best advantage in the application of these principles, but the principles are all there, and the practice of these mills has not added anything that I can see to the understanding of the principles stated.

WITNESS EXCUSED.

Thomas A. Janney.

THOMAS A. JANNEY, recalled on behalf of defendant, for further

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. Mr. Janney, have you recently conducted any mill operations with quantities of oil out of the ordinary?

A. Yes, sir; on April 29th our plant ran for eight hours, and I used 323.78 lbs. of oil per ton.

Q. 2. Was this test conducted under your personal supervision?

A. It was.

Q. 3. And in your presence?

A. I was there the largest portion of the time.

Q. 4. And to whom did you give immediate charge of the operation when you were not there?

A. Mr. Rex Sutherland.

Q. 5. Is Mr. Rex Sutherland here?

A. He is.

Q. 6. Who co-operated with Mr. Sutherland in this operation?

A. Mr. George Taylor and an operator whose name I have not got.

Q. 7. Is Mr. Taylor here?

A. Yes, sir.

Q. 8. In the taking of samples who participated?

A. Mr. Meading, who is our head sampler, had

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charge of the sampling, and he himself took the moisture samples of the feed going to the machine, with the exception of two samples which were taken while he was at dinner, and those two samples were taken by Mr. Mower.

Q. 9. Are Mr. Meading and Mr. Mower here?

A. They are; and Mr. Mower had charge and actually took all of the samples for oil analysis and metal analysis and the tonnage samples.

Q. 10. By what you have said it seems that he took all of the samples except the moisture samples, and he took two of them?

A. Yes.

Q. 11. And that the others were taken by Mr. Meading?

A. Yes, sir.

Q. 12. Now as to the assaying of all these samples of the mineral first; that is, metal and insoluble, who performed that operation?

A. Mr. Martin, our chief chemist.

Q. 13. And is he here?

A. He is.

Q. 14. Did he do this personally, this assaying?

A. Yes, sir.

Q. 15. You said duplicate samples were taken; what was the second sample for?

A. One sample was taken for oil analysis and the other sample was taken for metal analysis.

Q. 16. That is the one you just referred to that Mr. Martin assayed?

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A. Yes, sir.

Q. 17. Who made the assay for the oil?

A. Mr. Clauson, our oil chemist.

Q. 18. Is he here?

A. He is.

Q. 19. Now, will you describe first the apparatus in which this operation took place, stating whether it was part of the mill equipment, or what it is?

MR. GARRISON: At an appropriate time, if your honor please, I desire to introduce an objection. I do not care to object until counsel has fully gotten upon the record the equipment used or whatever the thing is, but I desire to warn the witness not to answer if he is asked to describe the experiment until I have had opportunity to interpose my objection.

A. The machine that I used is known as our No. 1 retreatment plant. This plant consists of two emulsifiers—

MR. SCOTT: I offer the blue print produced by the witness in evidence, the same being entitled "Flow Sheet of Concentrate Flotation Plant, Arthur Plant, Utah Copper Company."

MR. WILLIAMS: We reserve the right of objection, as this it seems will facilitate the testimony, so it would be well to have it before us.

Blue print admitted in evidence marked DEFENDANT'S EXHIBIT No. 219.

A. The plant in which this run was made is known

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as our No. 1 retreatment plant, and consists of two mechanical emulsifiers followed by thirteen frothing cells.

Q. 20. I wonder if you could not point that out on the blue print so that the court can more readily understand it. It is rather small.

A. In this particular test—

Q. 21. One minute, please. Are these two mechanical emulsifiers the two cells at the left of these—of this series under the words “No. 1 plant”?

A. They are illustrated by two circles. It says, “two emulsifiers in series.”

Q. 22. With that placard marking them upon the diagram?

A. Yes, sir. In this run I endeavored to make two products, one was a tailing, which was sent to waste, and all of the froth from the 13 cells was considered a concentrate. That is we did not circulate as illustrated by this flow sheet. This flow sheet represents our operations as we run from day to day.

Q. 23. The “middlings to elevator” part of this diagram did not figure when you were carrying out this test?

A. That is it, yes, sir.

Q. 24. The material just simply went straight through the 13 cells and out and that was the end of it?

A. Yes, sir.

Q. 25. Froth taken off and tailings discharged?

A. Yes, sir. Previous to the time that this test

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was made, in the regular operations, we circulated a middling and that middling went back to the two Dorr tanks and thence back to the flotation cell. 24 hours before this test run was made I cut out the circulating in the hope that there would be no trace of oil in the Dorr tanks when I started this run. But I found that when I started the run that there was a small amount of oil in the feed.

Q. 26. You mean as it came before you at the end?

A. Yes, sir, as it came to the flotation machine.

Q. 27. And how much was there?

MR. GARRISON: I object now to any testimony of these details of the experiment. I have no objection to their laying the foundation, the questions as to what that experiment disclosed, but I do not want to be prejudiced by evidence which I feel we have a right to exclude under our objection.

MR. KREMER: I think we all understand the situation. I think Judge Garrison might make his objection, state his grounds at any time so we might know what they are.

MR. GARRISON: If your honor pleases, this gentleman has testified that on the 29th of April, during the course of this trial, in fact only a few days ago, being a manager or mill superintendent—I have forgotten just which—he was, of one of the plants of one of the allied companies with the defendant—has, during a certain part of the day run a test. I cannot conceive under what head of evidence such testimony could be admissible. The utmost limits to which

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courts have gone, so far as I know, in permitting testimony of experiments not made in court, not made under the supervision of both parties, is by experts to illustrate or substantiate from those their testimony. It is a very grave question, in reading the opinions of the courts, including the Supreme Court of the United States, with respect to such testimony, as to whether it should not by the nisi prius court be excluded, because the ordinary form that is used by counsel in objecting to testimony by reason of its orderliness is quite often not carefully considered. We object because it is "incompetent, irrelevant and immaterial."

I have always considered that immaterial evidence was evidence the weight of which was so slight that it had no materiality. Now, the Supreme Court of the United States and other courts in this country, in dealing with the situation of experiments carried on by a party as an experiment and testified to by them, have practically said that such things are immaterial; they should receive no consideration.

But it is a waste of time to discuss that further than the sidelight that it casts upon the objection I am making. This gentleman is not there as an expert; he is not going to testify as to Kirby and Everson and Froment and so forth. He is a practical man; he is a fact witness and nothing else. I think it is the third time you have been on the stand.

THE WITNESS: Twice.

MR. GARRISON: The second time he has been upon the stand to testify with respect to operations

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with respect to the operations at his mill, as a fact witness. Now, isn't it most ridiculous—now, is it not a most remarkable sight, during the course of a trial—and I am going to use a word now in no offensive sense—evidence is manufactured and brought in. He goes off to manufacture this piece of evidence. He makes it and produces it. It is a fact question. He brings it in here with no possible opportunity for us to have any such relation to that fact as gives us a chance to test its verity. We will have nothing whatever except things written down upon a piece of paper.

Now, it is bad enough if the rule is held to be extended to experiments made out of court during the course of a trial by experts; but to a certain extent, the situation is alleviated there because necessarily he has to tie these things into a theory; and, if his theory is unsound or his theory is one of those rapidly changing theories, as all the theories in this case seem to be, it is not of much materiality, it doesn't hurt anybody very much, because what they think today they don't think tomorrow and we don't much care on what experiments they base their conclusion. But this is not this situation. This is a fact. This gentleman here is a fact witness. He is going to testify to facts. Now, I respectfully submit that in the whole course of the production of the body of law and of evidence in this country, I doubt whether you can find an instance where courts have countenanced the making of facts during the course of a trial.

How is it relevant to any issue in this case? The

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issue in this case is as to whether the patent in suit is valid and whether the defendants have infringed it. They have confessed infringement in their stipulation. Therefore, that issue is out of the case. How can this possibly—this fact that this witness made on the 29th of April—cast any possible light here on the question of whether the patent in suit was valid when issued? It cannot. Therefore under no law that I can see, that this case has developed, can this testimony be relevant or material or competent. I object to it as incompetent; I object to it as immaterial; I object to it as irrelevant.

MR. SCOTT: Now, in the first place, as to the time of this operation. I fail to see that that has any bearing the admissibility of the evidence. The investigation of a fact sheds light upon the fact regardless of whether the investigation is made during the trial or before the trial. We have had many experiments here already that may have been devised during this trial—doubtless they were. It is entirely immaterial. They are accepted as a means of shedding light upon the question at issue; and I cannot conceive how the question of time has anything to do with it.

Now, as to its having no bearing upon any question at issue here. It has the most direct bearing. The patent is based upon the assumption and has for its only foundation the proposition that there is a different phenomena taking place when the amount of oil is reduced below a certain alleged and fictitious critical amount. Now no one can deny that this experiment

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will shed light upon that question; that it will show that this fictitious amount is an absolute myth.

And as to the presence of the other parties at this experiment, the books are full of cases to the effect that it does not run to the admissibility of evidence at all. Of course the court in considering any evidence doubtless always will take into consideration the circumstances under which the experiment, regarding which evidence was offered, was performed; but this is a matter of credibility that has nothing to do with the admissibility of this evidence.

And, furthermore, here three or four days ago when we started to prove an operation similar to this one to which this witness will testify some objection was made on the ground that the other parties were not present. After some discussion we invited them to be present, to compare the operation. The offer was accepted and the acceptance of it is in the record and we have proceeded in view of that state of affairs, and we have ~~these~~ witnesses here this morning. We have all of the necessary witnesses to corroborate all of the details of the operation. And as far as the Supreme Court of the United States and as for there being dozens of decisions, or some such number as that, to the effect that the experiments by experts should not be considered, I can point to any number of cases in which the decision is hinged upon precisely such experiments. They have always been considered. I doubt if we will have any difficulty in bringing in cases upon that point.

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Therefore, I see no ^llegal objection to this witness proceeding with his testimony. The operation to which he testifies will be repeated under our previous offer and thus the only objection, even to the credibility of the operation, is removed, and I maintain that no objection dealing with the admissibility of the evidence has been offered.

MR. GARRISON: Now, if your honor pleases, Mr. Scott has with utmost frankness disclosed the purpose of this testimony. He has said and of course I do not have to concur in his construction, but he has said our entire patent depends upon a certain statement with respect to phenomena. He proposes by this witness to prove that the patent rests upon a falsehood. This evidence, if admitted in this case as evidence, he says will be decisive positively of the entire case. So that we are faced with a critical situation which, according to our opponents, our entire case is to be determined on whether this witness can testify what he did on the 29th of April and the results thereof.

Now, this phenomenon is one which requires for a determination expert knowledge of exactly what has been done and the results. We are so saturated now, after three weeks of this trial, that we know that the result, the method of operation, the mechanical principle, the nature and character of the froth, the position of the mineral, the situation with respect to the gangue, the action and subsequent appearance or disappearance of the oil, the action and subsequent appearance and disappearance of the acid, are all things of importance that cannot be exaggerated.

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Now, we cannot see any of these things. We are going to be faced with statements by this witness that the critical things which make this experiment, made where they wanted it to be made, were present, and how can we possibly disprove whether they were present or not. The only set of eyes, the only mouth, the only brain, that can testify is this gentleman. He is here proffered by the other side, and of course it is without any question therefore to be assumed that he will say that the things were present which are determinative, so Mr. Scott says, of the issues in this case.

In other words, we have got this proposition: That during the course of the trial with respect to a fact, a witness may be permitted to depart from the neighborhood of the court room, produce a certain set of facts, come in and testify to them and thus dispose of the case absolutely! If that can be permitted, if that is permitted, it does seem to me that all of the rules of evidence that it has taken centuries of care to build up in order that justice may be administered, with due respect to the opportunity to test the proof, are done away with.

MR. SCOTT: One more point I would like to make, your honor.

Now, this same objection, identical in substance and form, was made the other day, and an additional objection was made that the testimony then offered was hearsay. Now that was fully considered and after the noon recess I addressed myself to the court for the

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purpose of getting a complete understanding of the situation and I think I am correct in saying that the court's ruling in excluding this testimony was based simply upon the ground that it was hearsay, and upon no other ground.

THE COURT: Yes, but the court did not commit itself to any other proposition at that time. Even if it did, if the court was wrong at one time it wouldn't have any hesitancy in changing at another.

MR. SCOTT: I did not intend to make that argument.

THE COURT: Here is the proposition as the court sees it: Under proper circumstances, I do not think it is an objection to an experiment that the other side have not had an opportunity to be present, but experiments are of value, probative value, in any case, if they are had and made under the conditions of the act or fact which they purpose to illustrate. Now, this patent has been issued some 12 years, and you are having experiments today, as I observed the other day, in the light of 12 years' development and four remarkable years—or years of remarkable development of the process of this patent in suit. Now, are they under the conditions as they were when this patent was issued, when this discovery was made.

MR. SCOTT: They are the conditions with the quantities of oil that were stated were in the prior art precisely. These experiments he tried run up to about 16 or 17 per cent, I think, or as a matter of fact, three hundred and twenty-some pounds. The same quantity

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of oil that Everson mentions, approaching the quantity that Kirby mentions far in excess of the quantity mentioned in the California Journal, and far in excess of Froment's quantity, and it is upon the presumption that the improvements set forth in this patent is a new process, growing out of the reduction of the amount of oil named in the prior art. Now, we conducted these operations with exactly the steps described in the prior art—nothing to it except the powdered ore, the water, the oil, the agitation and the froth, and those are the things that are mentioned in the prior art, and that the prior art tells us how to do, and we have used this quantity of oil, the quantity mentioned in some of the prior art documents and beyond that mentioned in others, and we come here before this court confronted by this decision against us based upon the existence of a so-called critical point which marks of this patent from the prior art. We produce an experiment in which we use the quantities of the prior art with the step prescribed by the prior art, a quantity far in excess of that so-called critical amount; and I fail to see how the experiment can be immaterial, how it can have too little weight. It meets the issue squarely. It does what the patentees say cannot be done. It does what the prior art inventors said could be done.

THE COURT: Well, if it wasn't being done in those days and couldn't be done, if nobody knew how to do it and now, as you say, after all of these experiments you develop it is seen that it can be done, ought to have been done then, is it material.

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MR. SCOTT: We follow the exact directions of this prior art, and these patentees are no more warranted in coming before this court and saying that a given person is following their directions than the other patentees are in coming in and saying you are following my directions. The only respect in which anybody ever followed the directions of this patent in suit in a respect not shown in other patents, is in the practice of economy. And other patentees and inventors have set a sufficient amount, they have said as low as one per cent, and then this patentee happens to make a lucky guess that this process could be made successful, that it could be done with less than one per cent.

THE COURT: It is like all other attempts to solve a problem. Others had worked on it, of course, and all, so far as the evidence shows had practically failed in producing the particular froth that this patentee did. In due course of time these people—yes, perhaps by a lucky guess or a lucky accident—took the step and made possible, perfect what before they were simply striving to do.

MR. SCOTT: Our position upon that, your honor, is that these patentees did not tell us how to do it with less than one per cent. They said: "Do the same thing that all of these prior inventors did" and guess that you could do it with less than one per cent.

THE COURT: Well, at any rate we are coming pretty close to the end of experiments that the court will receive. I will give you until two o'clock, both of you, to bring in the authorities on this question of ex-

periments. The patent law must be full of it. You have mentioned them several times, but I haven't seen any authorities on these experiments. Let's have them at two o'clock.

WHEREUPON an adjournment was taken until 2:00 p. m. Friday, May 4th, 1917.

2 p. m. May 4, 1917.

MR. GARRISON: If your honor please, your honor will recall that in the early stages of this case, when the defendant began the introduction of present day operations, an objection was interposed that it was not relevant or material to any issue to be tried in this case. At that time I presented to your honor a series of authorities in England and in this country directly in point, the point being that where the question of validity is involved, and it depends upon the state of the prior art, no testimony is admissible with respect to the prior art unless it is given from the standpoint of the prior art, and the testimony which refers to the prior art in the light of later developments has but one purpose, and that is to confuse the issue and make it difficult for the court to see what otherwise would be simple. Mr. Scott, representing the defendant, at that time met the challenge and stated that he would connect these later day operations with the prior art, and would show that they were demonstrations of the prior art.

This test about which they purpose calling this witness, performed within a week, does not purport by

any of the testimony given by this witness—and by that alone can we test it now—to reproduce the conditions of the prior art. This witness is not proffered as an expert with respect to the prior art.

I find that the cases have had to deal with the conditions existing prior to the rule which now prevails respecting the trial of patent cases in open court. Of necessity courts in the past have had placed before them for their consideration all of the testimony taken before the master or examiner in chancery who took the testimony, and therefore the courts dealt with the evidence of experts with respect to tests from the viewpoint of the testimony that was already in the case, and the question was what should be done with it. Therefore it is not remarkable—in fact it would be very remarkable were it otherwise—that we do not find any law with respect to the admissibility of the evidence. We do find expressed in the disposing of the evidence what indicates the duty of the *Nisi Prius* Court under the modern rule, under which testimony is taken in its presence.

As a basis for what I shall say I refer to 83d Fed. Pages 696 and 697: “The complainant has endeavored to demonstrate that this testimony is untrustworthy and his expert has introduced a series of experiments to show that the method described by the defendant is incapable of producing a seamless cap. That complainant’s expert should prove the defendant’s methods inoperative is not surprising. An experience of 184 years in patent litigation has convinced the court that when an expert endeavors to prove that his adver

sary's machine will not work, he is always successful. It is much easier to make a machine that won't."

177 Fed. 717, page 721. The court said: "I give no weight to complainant's experiment made in the absence of the defendant; such attempts at the making of evidence are not to be encouraged."

165 Fed. 909-11. "We disregard altogether the reports of tests made apparently by a skilled operator, some of them in the absence of complainant or of doubtful interpretation and in all so few as to be valueless."

179 Fed., 701—at 77. "The record discloses attempts to demonstrate actual identity, but these are not produced in such shape as to avail the appellant. The courts place little weight on ex-parte demonstrations in any case, but especially is this true in regard to experiments with chemicals."

Now, keeping in mind that all these rulings were made where the evidence was already in the case, we find that even there, in dealing with experts, the courts have said that they disregarded their testimony. Now, if we disregard testimony, it must be because it is either irrelevant or immaterial or incompetent, and I assume that this was disregarded because it was immaterial, because it had no weight.

However, the main grounds for the exclusion of this evidence, it seems to me, is furnished by the facts that are incontestable. Its only possible relevancy would as to the matter of validity; there will be no pretense that it carries any weight whatever as to the question of infringement. Now, what materiality, what rele-

vancy can a procedure at the Utah plant, carried on in a machine invented three or four years ago, with materials not those of the prior art, in a manner not disclosed by any procedure in the prior art—have upon the question of validity in the case at bar. Without any extended discussion, we are advised from the view point of the defendant, as testified to by their experts, and the only one who has dealt with the prior art—Froment, with his (according to them) olive oil and the test tube; Mrs. Everson with her bread kneading process and her other process by which the position of the gangue and the metal is ~~recovered~~ ^{reversed} and the metal is washed off by methods well known in the wet separation of ores; and Kirby with his gentle agitation and elevation of an oil layer with the mineral clinging between the oil and the water and separating, by the novelty of his invention, which is the injection of oil and air—all are illustrated by methods in which none of those methods are used, none of those procedures are carried out, and a totally different result is achieved.

As to how far courts will permit experiments, I think without exception one in limine procedure is required of the person presenting the experiment, namely, that the conditions under which the experiment is produced are identical with those that they pretend to repeat. I have not attempted to bring with me the citations or quotations from the innumerable cases which hold that. What our position would be were these gentlemen to proffer through the mouth of this witness testimony of what he found to happen in a test tube

in Utah in the attempt to put olive oil and sulphuric acid and shake it up, according to the way he read the Froment patent, I will not take time to discuss. What would happen, similarly, if he told us what he did in his room in his home in Utah, by kneading the mass, according to Mrs. Everson, or by taking some apparatus well known in the wet separation of ores and following her second practice—or if he constructed a Kirby machine and operated it in his own room and told us the results—I will not say what position we would take toward those; but we think these gentlemen have themselves laid the ground work for showing that what this gentleman proposes to testify to is ~~conditions~~ *in no way* identical with those which they purport to represent—there is no possible basis in the law of evidence or the law relating to the trial of issues in patent suits to justify or vindicate this evidence, and there is an entire failure of it in such evidence, and I think the witness has already testified, when he was identifying his flow sheet, that these were Janney machines, and the evidence is already before you that they are a matter of three or four years of age; so that it is demonstrated before your honor that this can not possibly be any reproduction of conditions existing at the time of Froment, at the time of Everson, or at the time of Kirby, and if they are not, then there is no possible basis whatever for the introduction of this evidence in this suit.

MR. SCOTT: First, as to the identity of conditions, of course we all admit that the conditions of any incident must be reproduced with substantial identity.

I never knew of any requirement that the impossibility of absolute identity be complied with. Now, the only question of any importance bearing upon this matter is the mechanism employed. The patent in suit discloses and the complainant's testimony is that the apparatus there used was known 20 years before the patent was applied for or the alleged invention made. It is in evidence that all kinds of agitating apparatus were in existence before the prior art documents upon which we rely. That is the identity. We used agitators in this process before the court. It is not a question of mechanism. The process involves the mechanical step of agitation. The only elements involved in the process are these: the powdering of the ore, the mixing of the ore with water, the addition of oil and the agitation. This completes the whole process from beginning to end, and no question of identity can come up as far as to the process. That is the process as shown to the court, the apparatus was all known at the time.

Now, the authorities that Mr. Garrison has been reading simply confirm what I told the court this morning, that this question of experiments, whether made ex-parte or inter-partes, no matter how performed, merely goes to their weight and has nothing to do with their admissibility. Every case read by Mr. Garrison enforces this point. The point has never been analyzed in patent cases, so far as I know, because these experiments have always been received, and if we look into the patent cases all we see is the analysis by the court of the experiments with a view to judging their weight as evidence. In the general law,

course, the instances are many where these cases have been analyzed and there is one case in particular that I have a note of. That is *Berg v. Chicago & Rock Island Railroad Company*. In this case the plaintiff's children—two children had been injured on defendant's railroad tracks, and the defendant without notice to the plaintiff made certain tests to show that the theory of plaintiff as disclosed in the pleadings was untenable, and upon that state of facts the Supreme Court of Iowa commented as follows: "Defendant made certain tests without notice to the plaintiff. The court admitted proofs of these tests over the objection of plaintiff." The court goes on to say: "We think these tests were proper and if fairly made the facts disclosed thereby would be of great value in reaching a conclusion. We cannot adopt appellant's view that it is an attempt to manufacture ex-parte testimony. Instances are without number where, pending litigation, the parties have made tests, measurements and trials relating to facts in dispute, and they have been regarded as competent and as a quite satisfactory class of evidence upon questions of fact, and we are not favored with the suggestion against the reason of such a rule. Upon the question of the admissibility of such evidence, courts have never assumed that it was "manufactured" in the sense in which the term is used in argument. It is not the law that in making such tests, measurements and so forth, the opposite party is entitled to notice in order that he may be present. It is the right of each party in the preparation for trial to take all legal steps in the way of being able to meet

the issues of facts by proof, and in preparing for the presentation of his evidence no notice to the adverse party is required. When they are used—

That is the test—"When they are used the circumstances of their use, including motives for and all the conditions of an unfair or impartial use are matter that may lessen the value of the testimony." That is the end of the court's comments. That is the case of *Berg v. Chicago & Rock Island Railway Company*, 52 N. W. Reporter, 680, and it is found in the Supreme Court reports of Iowa 90th volume, page 106. In the case of *Byers v. Nashville Railroad Company*, 94 Tenn 345, the court says:

"It is next assigned as error that the court excluded the testimony of Henry Mangrum, who, at the request of the company, made an actual test to see whether the train that caused the death could have been stopped after the engineer saw or could have seen the man on the bridge. This witness proposed to prove that he ran the same train on a different day, after the accident, over the same place and bridge; that he had the same number of coaches; that in making the test, as soon as he could, by being on the lookout, see an object standing on the center of the bridge, he applied every means known to him or other skillful engineers, and used every endeavor, to stop his train, and that it was impossible to stop such a train before passing over the bridge and that his entire train passed over the bridge before he was able to stop it. He further would have testified, if allowed, that he applied his air brakes, reversed his engine, and used every means known to en-

engineers to effect the stop, but was unable to do so. This test was made by Mangrum for the purpose of making him a witness and proving the result of the test. This evidence, on objection, was not allowed to be given. The authorities in other states are conflicting upon the admissibility of such evidence, and we have been cited to many cases, all of which we have examined. In our own state it has been held that the evidence of an expert is not incompetent because of an ex parte examination, investigation, or experiment made by him. Nor is such evidence inadmissible because the experiments were made after the suit and trial has begun, and with a view to being used as testimony in the case. The objection in such cases does not to the competency or admissibility of the testimony, which is a matter for the court to determine, but to its weight and sufficiency before the jury; and especially is this the case where the experiment is made ex parte, and is such that it lies wholly within the power of one party, and wholly beyond the power of another party, to make such experiment. We have been cited to quite a number of authorities to sustain the contention that such evidence is incompetent and inadmissible in cases where the experiment is not usually within the reach of both parties, but we have not been able to find this doctrine sustained. We do find cases, however, holding that, where the experiment is made ex parte, it affects its weight that it is not made after due notice to the opposing party, and giving such party opportunity to be present and the test applied. That such evidence is compe-

tent, but its weight to be duly weighed by the jury, is supported by the following authorities: *Boyd v. State*, 14 Lea, 161; *Lipes v. State*, 15 Lea, 125; *Railroad Co. v. Ayres*, 16 Lea, 725; *Railroad Co. v. Champion* (Ind. Sup.) 32 N. E. 874; *Underh. Ev. P.* 201; and other cases in accord. It is uniformly held that in all such tests, to make them competent, the conditions under which the tests were made must be the same as near as practicable. This requirement appears to have been substantially complied with in this case, and, judging from the testimony offered to be given, the conditions of the test were essentially the same as when the accident occurred. We are of opinion the trial judge was in error in not allowing evidence of this test to be introduced, under proper instruction to the jury as to its weight. We cannot speculate on what might have been the verdict of the jury if this evidence had been allowed to be introduced. It was upon a vital point in the controversy. The plaintiff had been permitted to prove by a witness that he had gone upon the tracks, and measured the distance at which a man could be seen standing in the middle of the bridge; and a hot contest was made over the question how far a man could be seen on approaching the bridge, and opinions pro and con were introduced on the question whether it would be possible to stop the train after reaching a point where a man could first be seen by a lookout upon an approaching train. This is the turning point in the case, and the evidence was very conflicting; and for the error of the court in

rejecting evidence of this test, properly limiting its weight and sufficiency, the cause must be reversed, and remanded for a new trial."

Now, there is a parallel between that case and this case. Here, this patent before the court is based upon an experimental test. Some gentlemen in London, some 11 or 12 years ago, took a little laboratory machine such as we have here, with their knowledge of the prior art, either actual or constructive, and it makes no difference which, although probably actual, with full knowledge of the prior art respecting the quantities of oil which this witness will say he used, and smaller quantities and larger quantities, with full knowledge of those facts, they take this little apparatus and perform an experiment with which they get a froth with less than one per cent of oil, and then they go forth to the world and say: this is a discovery, these people that went before couldn't do this and no man ever did it before.

We offer this testimony to show that what these prior art inventors disclosed could be done when they invented it, could be done when these men in London put this fiction before the world, and that it can be done today. What are the conditions of the prior art that we reproduce? They are the powdering of the ore, which this witness has done in this experiment or had done for him; its admixture with water, the addition of oil in the amount named in the prior art, larger quantities maybe than the prior art inventors named—and the last step, agitation. Here is represented every condition. He has done it in a

receptacle made of iron while some of these prior art people may have made it of wood. It may be that he turned the agitator with an electric motor while they may have used a water wheel. That is no departure from the substantial identity of conditions. And therefore I maintain that there is not a single criticism put forth by Mr. Garrison that will stand the test of adjudicated cases or of reason.

MR. GARRISON: I only want to say one thing, to say that the cases all hold just as Mr. Scott has read from his cases, that the person performing the test has illustrated that the conditions of the test represent and reproduce what they purport to represent and reproduce, in his case a railroad track, same engine, same cars, same place, same bridge. Until they do that, it is not admissible, and so far from their having laid that groundwork, their testimony shows that so long as they use this equipment that they have at this mill they cannot even pretend that they are representing anything that the prior art disclosed or anything that puts us in the position of the prior art.

THE COURT: The court will consider for a moment what was said when this character of evidence was first offered. —

(Whereupon a short recess was taken.)

THE COURT: This objection seems really to bring us right back to where we were on the day when the defense first offered evidence of what was being done in other plants for while before noon the objec-

tion was based upon the ~~fact~~^{fact} that experiments are not admissible at all, and while that ground has not been abandoned since noon—and I think before noon the objection was also made that it was not illustrative of the prior art—all of that was met by the court's ruling originally when this character of evidence was offered at that time, that it was going to be, as the defendant promised, connected up and shown to be illustrative of the prior art. As I have said before, the proof in this case must be that of the prior art. ~~More~~^{More} subsequent developments, improvements, discoveries, will not have weight and properly can have no weight in the final determination of the case. But it is said still that this was the prior art. As far as experiments are concerned, they are subject to both criticism and suspicion. I would not go as far as the cases that counsel has read from, absolutely refusing to consider such evidence altogether, the 177 and 165th and 179th Federal—or that expert testimony before the court is of no value, because it does not seem to me that that is in accord with either logic or principle; it does go to its credibility or weight, and how much the court will give to either to that variety of testimony. It is necessary that the conditions shall be the same of course, or otherwise the experiment is wholly misleading. I suppose every judge who has sat on the bench has had plenty of evidence of experiments brought before him one time or another. The case counsel read from last indicates that, and also it has been so in this court. Conditions must be the same. If John Doe was being

prosecuted for shooting Richard Roe with a gun at a distance of 500 yards, it would certainly be competent for the defense to come in and show that the gun, by actual experiment, would not carry that far: but it would also be necessary for the defense to show that it was at the same range and the same sort of ammunition, that the gun was held at the same angle or at least at the most favorable angle; for ^{if} it was shown that the shot was fired at a thousand yards, the experiment would be worth nothing. I think the court observed in a former ruling as to what can be done today as to experiments is correct, that it all turns on the substantial identity. Another remark the court made was that there is already evidence in this case that the defendant is operating and has operated with more than one per cent of oil specified in the patent, and plaintiff not having explained its position in reference to that—the time not having come—it might be that the plaintiff might claim that such operation could not be conducted with that amount of oil. Certainly, to meet that contingency, the defendant would have a right to show that they can be conducted. Plaintiff might claim that they could not be conducted under any other conditions than the Butte & Superior conditions, and it would be competent for the defendant to show, as corroborative, that they can be and that they are being conducted elsewhere.

Now, this experiment which the defense proposes

to put in evidence is of the same character of regular operations; I think you might say that it was conducted long enough to bear a semblance to the regular operations which are covered by the stipulation. I think one of the objections raised the other day was that it was only an hour, and hence it could not come within the stipulation.

Having started out upon the theory that the defendant can introduce this evidence as illustrative of the prior state of the art,—Of course it must be shown by proof; it is not sufficient to claim that is the prior state of the art—The court will not change its ruling now, but as I said before you are getting close to the limit as to the number of these experiments which you will be allowed to show. As Judge Holmes puts it in a Massachusetts case, the court must control that, and not allow them to continue for the length of a man's life, if not for eternity. I can not wait here while you go to Utah and make experiments indefinitely. So this objection will be overruled, but bear in mind that you are getting pretty nearly to the end. I am not prepared to say that counsel has failed—He has not put all his case in in defense yet—to show that these conditions come fairly within the prior state of the art, but I am prepared to say that counsel has a heavy burden on him to show that. Of course I have observed here before that this case is being tried, as far as the evidence is concerned, as though the Hyde case never existed; but with the presumption of validity attaching to the patent in suit, and the

Supreme Court standing back of that patent, the defense knows what it has to overcome. So we will allow you to proceed, and in the end we will see whether it is, as you claim it is, illustrative of the prior art.

MR. SCOTT: I would like to inform the court that I wish to present this witness, and that after that we have in the Grand Jury room a model machine which we would invite the court to see operate.

THE COURT: I might have said I do not see why these experiments should not have been made in the plant here at home. I don't see why you should invite the plaintiff to run outside of the jurisdiction of this court to see these experiments. I say you are entitled to introduce them under the plaintiff's authorities, regardless of what some of the Federal authorities say—entitled to introduce them, whether they have seen them or not. It goes to the weight and to the credibility; at the same time I do not see why these experiments should not have been conducted in the plant here. The court might want to see them, and of course the court is not going out of the jurisdiction.

MR. SCOTT: It was a matter of convenience as to which plant could most handily do it. The plant which we refer to is a model plant, installed on the upper floor, and we would like the court to see that.

THE COURT: Of course the court is not saying that you have put in your last experiment, but is simply suggesting, strongly, that you have used pretty

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nearly what the court would consider a reasonable time. The objection will be overruled and an exception will be noted.

Q. 28. Do you remember, Mr. Janney, the point that you had reached; we were discussing the construction of the plant, and you had stated that it was your No. 1 retreatment plant, consisting of 2 emulsifiers and 13 frothing cells. Will you complete your description of the plant in which you conducted this operation with 323.73 lbs. of oil?

A. In my earlier testimony I described that we had two emulsifiers and 13 frothing cells in series. All of the concentrate from these 13 cells was sent directly to the concentrate bins, and the tailing was sent directly to waste, and there was no circulation, as in the operations previously testified to.

Q. 29. Now, before you begin this test, as I remember, you stated this morning that you took some precaution to prevent any oil or any great amount of oil additional to that directly added being present?

A. Before I left Butte I telegraphed to Salt Lake, or to Garfield, rather, to have the circulation discontinued.

Q. 30. By circulation you mean the return of the middlings?

A. The return of the middlings.

Q. 31. And in the regular operation of this machine, just state where those middlings did go back to.

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A. In the regular operation of this plant the middling was returned to two elevators, and the pulp is there elevated to two four-spigot classifiers.

Q. 32. Those marked "Janney Classifier" at the left hand of the sheet, isn't it?

A. Yes.

Q. 33. Elevated to the classifiers. What are those classifiers for, primarily?

A. I might state that, in addition to the middlings going to the elevators, the original concentrate that is from the vanners in the mill also discharges into the same elevator, and with the middlings it is elevated to these two classifiers.

Q. 34. When you speak of the material from the mill, you mean the tailings from the gravity treatment in the mill?

A. No, it is the concentrate from the vanner, and part of that feed is what constitutes the feed to the flotation plant. These classifiers are used for the purpose of removing the coarse material, and this coarse material is treated by the Wilfley tables.

Q. 35. That is indicated on the drawing by the placard "Spigot to Wilfley Table"?

A. Yes, and the overflow from these classifiers is delivered to two Dorr thickeners, 44x12 feet, designated as Dorr tanks on the print. In my previous testimony I stated that these tanks were 44x20; I find they are 44x12. The overflow from these Dorr thickeners is wasted, that is, it is not used any more, and

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the thickened product is divided between two plants, and inasmuch as I am only dealing with one plant in this experiment, I will refer to that plant only.

Q. 36. The two plants are indicated there by No. 1 plant, 13 cells in series, and lower down, No. 2 plant, 15 cells?

A. Yes.

Q. 37. And you are going to confine yourself to No. 1?

A. To No. 1, yes. Now, as the thickened product from the Dorr tank enters No. 1 plant, enters the emulsifiers, oil is added.

Q. 38. That is the place where it is so marked, "Oil Added"?

A. Yes, and our alkaline reagent is also added at the same place. The pulp, oil and reagent pass through the two emulsifiers, and thence to the flotation cells.

Q. 39. Now, Mr. Janney, I see as this sheet is made now, that you have a placard here, "Concentrate from Upper Cells to Concentrate Bin; Number Left to Judgment of Operator." And below that there are several other cells, the froth from which goes back as middlings to the elevator. What is the effect of bringing back those middlings upon the oil supply?

A. It increases the oil supply.

Q. 40. Now, you had just got to the point of stating, I think, that you had the circulation cut out. You telegraphed to have the circulation cut out before you went to Salt Lake. Will you please state

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what the effect of cutting that circulation out was upon this oil supply?

A. Well, my object in having the circulation cut out was that in this test I would be dealing, as nearly as possible, with a pulp that had no other material in it except the feed that came from the classifiers. But the time allowed was not sufficient to allow all of the oil that was contained in these tanks to work out of the system.

Q. 41. In the Dorr tanks, you refer to?

A. Yes.

Q. 42. That is, some of the old material kept the oil in there?

A. Yes.

Q. 43. How long was this running without circulation before you started this test?

A. About 30 hours I believe it was. I believe I mentioned 24 hours, but that was just a rough figure. It was 30 hours.

Q. 44. Now, how much oil per ton of ore was there in the feed during this test, before you added the oil which you did add for the purpose of the test?

A. 1.04 pounds per ton.

Q. 45. That amount was in there by virtue of the residue in the Dorr tank?

A. Yes.

Q. 46. Would that 1.04 pounds per ton cause the formation of a froth concentrate?

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MR. GARRISON: That is objected to as speculative.

(Question withdrawn.)

Q. 47. Did you ever use the same mixture in amount as low as one pound per ton?

A. The lowest we used was in a test that I testified to earlier in the case, in which I used 1.6 lbs. of original oil, and I think there were four and a fraction pounds there already, so that the total was 5.68 pounds, if I remember correctly, and the results were negative.

Q. 48. By negative what do you mean?

A. They were not good results.

Q. 49. Did you ever run without oil at all—that is, without new oil added?

A. Yes.

Q. 50. What was the result then?

A. I noticed a few stray bubbles on the first spitz, that was all.

Q. 51. What were the conditions then as to residue of oil in the Dorr tanks as compared with the condition when you conducted this test with 323 odd pounds of oil?

A. I believe there was in the neighborhood of four pounds per ton of oil.

Q. 52. And that gave only a few stray bubbles?

A. Yes—Well, I did not run that test with that oil amount; that was 1.6 pounds of new oil added to that, and I did get some froth on that test. I have

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not run a test where I used just the four pounds of oil in the circulation alone.

Q. 53. You have not made a test just with the oil that was left there from the circulation?

A. Well, not knowing the quantity of oil I haven't; I have run the machine, but I don't know how much oil was in the circulation.

Q. 54. Have you a statement containing a report of the operations of these gentlemen who are here and who worked under you in conducting this test?

A. Yes.

Q. 55. Will you produce copies of it or have I got them?

A. You have them.

MR. SCOTT: I offer this statement in evidence, entitled "Utah Copper Company, Arthur Plant, Metallurgical Department, Eight Hour Test made in Retreatment Plant, etc."

Table marked DEFENDANT'S EXHIBIT
No. 220.

Q. 56. What was done with the products, the concentrates and tailings before the assays were made; were they simply assayed as they came from the machine ordinarily?

A. All samples were taken in duplicate, one sample was taken for the purpose of determining the amount of oil in the product, and the other sample was taken for the purpose of determining the amount of metal in the products, and the samples taken for the oil

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analysis were taken by means of a cutter, having a one-half inch opening. These samples were taken every 15 minutes throughout the test, and the composite sample was allowed to accumulate during the test. The buckets containing the oil sample were delivered to our laboratory and turned over to Mr. Clauson who made the oil analysis. Like samples were taken for metal analysis, only the samples, after being collected, ~~were~~ delivered to Mr. Mieding, who has charge of our sampling, and he saw that the samples were properly dried, crushed, rolled and delivered to Mr. Martin, our chief chemist, at the assay office, who personally made the analysis^es.

Q. 57. Now, at the bottom of this sheet, which is exhibit No. 220, I find a note as follows—

MR. WILLIAMS: I wanted to read this paper before expressing any objection, and having done so, I find upon it evidence that the operations could not by any possibility be a reproduction of any of the patents that are relied upon by the defendant. The mixtures are fuel oil, Jones oil, American creosote and Yaryan pine oil. Pine oil was never used in flotation until years and years after our patent was granted; none of these other oils are the oils mentioned. There is an alkaline reagent here, 6.37 lbs. per ton, and I don't even know what it is, but judging by that plan, it is Calura, a recent invention in the art. The document shows upon its face that it is not an operation of the prior art, therefore no object to its reception in evidence and any testimony in regard to it.

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MR. SCOTT: In the prior art patents, noticeably the Everson patent, she mentioned animal and vegetable oils generally, but never published all the different kinds of oils that might be used; it was impossible to name them all; Everson named various reagents to be added to the pulp, in her patent, and furthermore the argument advanced by Mr. Williams has no bearing upon the point at all. The process of Everson would be here none the less, or any of these other prior art inventions, notwithstanding that other things are here also. We have followed the Everson directions as set forth in the patent. She advises the use of a long list of different reagents, both acids and salts of every conceivable nature, and she names some of the salts she has used. She does not name them all; she names probably six or eight or ten. She speaks of the use of salts, and strangely enough, it is found in modern practice that the use of such salts is beneficial. She speaks there of the use of copper sulphate, which has been used since by the Butte & Superior.

THE COURT: It is in line with all the former testimony, and the court will adhere to its ruling. Perhaps this special objection was not made heretofore, but of course it will be a matter for argument later on. I think one witness testified to having a thousand different oils in his laboratory. Many of the results obtained today are traceable, according to the evidence, to new mixtures and combinations of oil. Whether that is part of the prior art is another thing.

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The question whether these oils are differently combined—and thus have different effects—I think they must, or they would not take so much trouble to mix them. At this time the objection will be overruled.

Plaintiff excepted.

Q. 58. I note at the bottom of your report, exhibit 220, the following note is made: "On account of products containing so much oil, they were dried with an oil solvent before the metal assays were made." Explain why that was done.

A. In this particular test, during the eight hours about $14\frac{1}{2}$ tons of oil ~~was~~^{were} used, and only 91.3 tons of material were treated. It was necessary that this oil should be washed out from the product in order to get a true metal assay of the product, and it was for that reason that I washed them.

Q. 59. Does this table show the amount of oil in the concentrate?

A. Yes, it is on the last column at the right of the sheet, on the fifth line down under the tabulation; 680.175 lbs.

Q. 60. There was 680 pounds of oil on the concentrates by assay?

A. Yes.

Q. 61. And is your pounds by weight of the concentrate increased by that 680 pounds of oil on them?

A. That 680 is not the oil contained in a ton of material rejected at the tailings, but it is the number of pounds of oil that would be carried out with every ton of concentrate produced.

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Q. 62. In every ton?

A. Yes.

Q. 63. Then you started with 91 tons of heads—of course that was without any oil at all?

A. Yes, that had one pound that came from the Dorr tank.

Q. 64. And would your results have checked up if you had figured your original tonnage as 91 tons, without this added oil, and then figured your concentrates with 680 pounds per ton of oil added to it?

A. I don't think I quite understand your question.

Q. 65. Well, your operation would have ended with more material than you began with if you had not taken the oil out, wouldn't it?

A. It would have ended with the amount of oil—with an amount of material equivalent to the amount of oil that I added to the machine.

Q. 66. Would another way of correcting that have been to have added the weight of the oil to the heading?

A. That would have been one way of correcting it, yes.

Q. 67. Instead of that, you washed the oil out of the concentrate?

A. Yes. I also washed the oil out of the tailings and heading.

Q. 68. Now, why is it that the combined amount of oil in the concentrate and tailing does not equal the amount of oil that you added?

A. That is due to the discrepancy in the oil analysis. On account of the concentrate containing so

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much oil I found it a difficult matter to dry off all of the water without carrying some of the oil with it. In this particular case I think it took over 24 hours to dry off the water before we could take a sample to determine the oil in it.

Q. 69. What kind of mixture was this froth after it was broken down and was being dried?

A. This concentrate mixture consisted, after it was put on the steam bath and the bubbles broken down, of a layer of oil floating on top of the water, and as the steam would be generated underneath the oil, it would bubble up through, and I am of the opinion that when this steam would rush through it would mechanically carry some of the oil with it. Also, on account of the oil standing in the presence of the air so long, I think some of the lighter oils volatilized.

Q. 70. Then the amount of oil, I see by these assays, adds up less than the amount that you actually added?

A. They do.

Q. 71. And therefore the figures here given of the amount of oil on the concentrates and tailings would be less or more than the amount actually present?

A. What do you mean, actually present; the amount added?

Q. 72. Yes.

A. It would be less than the amount added.

Q. 73. What would be the total pounds of oil shed per ton, based upon the amount of oil in the product?

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A. A little over 217 lbs. per ton.

Q. 74. That is based on the oil assay figures?

A. Yes; based on the amount of oil in the concentrates and in the tailings, and the amount of oil was 217 pounds.

Q. 75. As against the fact that you actually did have 323.78 pounds?

A. Yes.

Q. 76. How much of that oil can you account for by the oil assays of the concentrate and tailings, as compared to the amount of oil added?

A. Approximately 68%.

Q. 77. Have you told everything that you personally did in connection with those tests—with this test so far?

A. No, I have not. I gave instructions as to how this test should be run, that is, relative to what should be considered concentrates, how much oil I wanted used, and after those instructions were given I watched the operators in charge, to check the tonnage samples and the amount of oil added, and I would go there about every half hour and see that conditions were the same.

CROSS EXAMINATION

BY MR. WILLIAMS:

X-Q. 78. How much of that oil was left in the plant at the conclusion of the operation?

A. We started the test at 5.45 p. m. April 29th, and we considered the test stopped at 1.45 a. m. of April 30th, and we discontinued sampling, I believe

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it was 30 minutes after we considered the test ended. That is, I had made determinations on that plant, and I found that it takes about 30 minutes for the feed to travel through the machine.

X-Q. 79. I was wondering how much of that oil was left sticking to the spitzkasten and other parts of the appliances. You have lost something like 32% of the oil. Don't you think that you lost some of it by reason of the fact that it did not come out of the plant?

A. I did not look into the machine to determine that. It would be quite a job to do that.

X-Q. 80. You don't know but what you left the plant in a pretty dirty condition as to oil?

A. Well, I can't say. What I could see was all right.

X-Q. 81. I don't find in your statement any separate determinations as to the overflows from the 13 different spitzkastens; did you make them?

A. All we would know would be the total amount that the whole 13 spitzkasten were giving forth; is that right?

A. Yes, that is correct.

X-Q. 82. Now, you ran the plant for 30 hours without circulation, but in the regular operations before the experiment?

A. That was before the experiment was started.

X-Q. 83. You cut off the circulation but you did not stop the plant?

A. That is correct.

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X-Q. 84. What sort of operations did you carry on in the plant in that 30 hour period?

A. Well, regular operations, using approximately 21 pounds of oil per ton.

X-Q. 85. Using what kind of oil?

A. The same mixture which was stated in the table.

X-Q. 86. So that you did not stop the machine at any time; you did not stop the plant; you just started to put in this extra oil?

A. Yes, the extra oil was started then.

X-Q. 87. Now, you said that a determination was made of 1.4 pounds per ton of oil still in the feed before the point of oil addition. What kind of oil was that; do you know?

A. We do not make a determination to determine that. I don't know what kind of oil it was.

X-Q. 88. Probably it was dissolved oil, wasn't it?

A. I can't say as to that.

X-Q. 89. Won't your examination show that?

A. No, our oil determination does not differentiate between the kinds of oil contained in the feed.

X-Q. 90. Well, your creosote had phenol in it. Would that be counted as an oil in your determination?

A. Well, to the best of my knowledge I think it is.

X-Q. 91. It is in the oil when you feed it in?

A. Yes, sir.

X-Q. 92. It goes in to solution and then as I un-

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understand it your method of determination catches it although it is in solution? That is right?

A. I think so, in small quantities like that.

X-Q. 93. So that that determination includes whatever of phenol there was in that creosote that was fed to the plant?

A. I think so.

X-Q. 94. Was all the oil fed in together at the point marked "oil added here" on your diagram?

A. Yes, all the oils were mixed together and were delivered to this point as indicated on the print by means of a little centrifugal pump.

X-Q. 95. Did you heat the oils in mixing them?

A. Yes, they were heated when they were mixed.

X-Q. 96. So they went into the plant in a heated condition?

A. Yes, they were warm. They were not—well, they were heated, yes.

X-Q. 97. And of course the water at this season of the year is very cold, isn't it?

A. I don't know what the temperature of the water would be.

X-Q. 98. You would expect it to be quite cold, wouldn't you, in your plant?

A. The atmospheric temperature on that day was I believe in the neighborhood of seventy degrees F.

X-Q. 99. You don't have your water at atmospheric temperature, do you, in your plant?

A. Can't expect to, no. That is the only way I can tell you what the temperature of the water was.

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X-Q. 100. You didn't take the temperature of the water?

A. No, sir.

X-Q. 101. You didn't take the temperature of the oil as it was fed in?

A. No, sir, the oil was added at the same temperature as it is always added during our operations, same kind of oil, heated to the same degree. We have a vat with a steam coil running through it and that steam coil is allowed to be on all the time. We have to heat all of our oils, no matter what kind they are. Even our creosote oils have to be heated. In them there are certain constituents that otherwise would precipitate out.

X-Q. 102. You did not give us the actual discrepancy in your figures between the oil that you put in and the oil that you got out, but I compute it as 9,388 pounds. That is a tremendous amount of oil, isn't it, to lose in an operation of a few hours.

A. Well, not considering the amount of oil used, 30 per cent I believe is what it figures—32 per cent.

X-Q. 103. Don't you agree with me that you will find people at work now to get the oil out of that plant?

A. No, our operations went right on the same; we didn't notice any difference after we discontinued this test.

X-Q. 104. Now, how about the oil that went into this dilution, that is the soluble frothing agent that was present there? Did you figure carefully all of that?

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A. I am not a chemist, Mr. Williams, and I am not in the position to state.

X-Q. 105. Well, when you took your samples?

A. Oh, yes, absolutely.

X-Q. 106. You took all the water that was there?

A. Every bit of that was taken.

X-Q. 107. Now, Mr. Janney, when you were on the stand before you promised to get a flow sheet of the plant and I take it that this flow sheet that you have put in is a complete flow sheet of the vanner concentration flotation plant, is that right?

A. Yes, sir. And while you speak of it there was one correction I wish to make before I forget about it. You asked me while I was on the stand before how we determined the amount of oil in our circulating feed and I said that our circulating feed was determined by tonnage samples and a representative sample was taken to the laboratory and an analysis made of it. I believe that is what I conveyed to you. But as a matter of fact, that tonnage sample is taken at the point I have indicated on this print as such, and that sample is determined by analyzing the feed for a number of tests before it goes into the emulsifier and the amount of oil found in that feed is credited to the tonnage of circulating feed. We do that for the reason that some of our oils might flow off from the Dorr tank and not go back to the flotation machines.

X-Q. 108. Of course there is an overflow from all of these Dorr tanks all the time that goes to waste?

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A. Yes, sir, that is the reason why we determine our oil in the circulating feed at a point after it is discharged from the Door tank and before entering the flotation machine.

X-Q. 109. And it would be a very reasonable thing for any, loose oil to rise to the top of the tank and overflow, wouldn't it?

A. Yes, sir, but I have noticed it on several occasions. As a matter of fact in my inspection, that is one of the things I noticed very closely, to see if any oil was going off the tank, and I don't know that I have ever noticed any perceptible amount of oil going over with the overflow. But in case there was any going over in the overflow, we don't credit that to our circulating feed.

X-Q. 110. I understood you had a table in which you had added certain things that I asked for. Have you got such a table?

A. I think Mr. Scott has that.

MR. SCOTT: Maybe it would simplify matters if I would substitute this exhibit instead of having the two in. It is just the same but with the added column.

MR. WILLIAMS: I think so far as the record is concerned if it appears in the record that it is stipulated that the other be withdrawn and this substituted in its place, that would be all right.

MR. SCOTT: Well, then let the record show that it is stipulated that exhibit 30 be withdrawn and the paper which I now offer be admitted in its place and marked Defendant's exhibit 30, subject to comparison by opposing counsel.

Thomas A. Janney.

THE WITNESS: I have not personally checked these figures. There may be typographical errors in it, but I will have it done and if there are any errors I will notify you.

The sheet in question was marked "Substitute exhibit 30, admitted".

X-Q. 111. What is this alkaline reagent which appears on exhibit 220?

A. That is the same reagent we use in our general operation. I believe I described it in my earlier testimony.

X-Q. 112. Calura?

A. That is the name we give it.

X-Q. 113. That originated in your plant, did it not?

A. It did.

X-Q. 114. Do you know who invented it?

A. Mr. R. B. Martin.

X-Q. 115. And it was invented, we will say, within the last five years some time?

A. As far as I know it was.

X-Q. 116. It doesn't appear in Nature, that calura?

A. No, we make it right at the plant.

X-Q. 117. Now, you haven't any of the baskets or Callow cells shown in your flow sheet. Do you use any in your plant?

A. Not in this plant we don't. It is a straight mechanical machine.

X-Q. 118. And no pneumatic attachment in any way to any of the spitzkastens?

A. None whatever.

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X-Q. 119. You testified about another plant, didn't you?

A. Our slime plant, yes.

X-Q. 120. Have you given me a flow sheet of that?

A. I think Mr. Scott has that.

MR. SCOTT: I will offer this flow sheet produced by the witness, the same being entitled flow sheet for slime flotation plant, Utah Copper Company, Arthur plant.

Flow sheet admitted in evidence and marked
DEFENDANT'S EXHIBIT 221.

MR. SCOTT: Suppose you describe this drawing briefly?

A. Do you want me to go into detail?

X-Q. 121. Tell us what it shows?

A. It is self-explanatory. That feed that comes to our flotation plant is the slime that is produced in grinding the original ore and consists of our classifier overflow. That is delivered to one 75 by 12 feet Dorr thickener. The overflow is returned to circulating—that is, returned back to our reservoir and the thickened feed goes to the flotation plant, consisting of six independent flotation units, each unit being composed of two emulsifiers in series, followed by five mechanical air cells in series, making a total of 12 emulsifiers in the plant and 30 mechanical air cells. The feed, after coming from the Dorr tank is divided by means of a distributor pipe to each of these six independent units. Oil is added before the pulp enters the units. The

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tailings from the last cell of each unit is discharged or rejected. The concentrate made in these three cells is pumped to an equalizing tank or a small tank which takes up the pulsation in the pulp, and this product is distributed to five independent units consisting of two mechanical air cells in series, making a total of ten cells in the whole plant. That is the cleaner plant as this plant is called. The tailings from this plant is returned to the 75 by 12 foot Dorr thickener and the concentrate goes to our bins and to Portland filter.

X-Q. 122. As finished concentrate?

A. Yes, sir.

X-Q. 123. Now, in your drawing of the upper part or rougher plant, you draw the emulsifiers just the same as you draw the mechanical air cells?

A. This is just a diagrammatic representation of the plant.

X-Q. 124. As a matter of fact the emulsifiers have no spitzkasten, and the air cells have spitzkastens. That is right?

A. Yes, sir.

X-Q. 125. Are these mechanical cells of the double spitzkasten variety or the single spitzkasten variety?

A. This is a mechanical air, as we call it, it is a double spitzkasten variety.

X-Q. 126. That is to say, each one of these cells consists of a separate agitation chamber, a spitzkasten at one side and another spitzkasten at the other side and then on each of these spitzkastens there is

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a sort of false bottom, with a canvas bottom, and compressed air is forced in, is that right?

A. Yes, practically.

X-Q. 127. And that runs on all through the plant?

A. Yes, sir.

X-Q. 128. Everything there is mechanical air?

A. Yes, sir.

X-Q. 129. Now, in your experiments in the slime flotation plant as stated in your table exhibit 32, you have a series of numbered experiments and you have not identified them by the dates and durations of the experiments, although I had you do that as to the others. Will you supply that information now?

A. I haven't the data right here at present.

X-Q. 130. Please obtain the data and let me have it.

A. The duration is given on there.

X-Q. 131. The duration is given but not the succession?

A. That is the time of the test?

X-Q. 132. The data as to the shifts, if you have that, because they are nearly all one shift and some of them half shift operations?

A. I will do that.

X-Q. 133. And then there was a little doubt in your mind as to what shift some one of the experiments in the vanner concentrate plant occurred in. If you can supply that also, please do so?

A. Yes, sir.

Thomas A. Janney.

RE-DIRECT EXAMINATION

BY MR. SCOTT:

R-Q. 134. How much oil per ton was found on the tailings as shown by this exhibit 220, your report?

A. 20.73 pounds per ton of tailings rejected.

R-Q. 135. Did you observe the appearance of the float formed during this run with 323.78 pounds of oil?

A. I did.

R-Q. 136. Will you describe it and compare it with the float upon other occasions?

A. The froth produced was composed of a mass of air bubbles, minerals, some slime and oil. Had every appearance of a froth produced in our plant with the exception that it was considerably more oily. The oil was very apparent.

RE-CROSS EXAMINATION

BY MR. WILLIAMS:

RX-Q. 137. What you said applies to the bulk of the concentrates as a whole?

A. No, it was that way throughout the whole plant.

RX-Q. 138. It looked all alike in every one of the 13 spitzkastens?

A. No, there was more on the upper cells.

RX-Q. 139⁹. The first cell overflowed a tremendous amount of oil, didn't it?

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A. The first five cells seemed to be about the same.
RX-Q. 140. Overflowing great amounts of oil?

A. Yes, sir.

RX-Q. 141. And then as you went down the line
the oil condition diminished?

A. Yes, sir.

RE RE-DIRECT EXAMINATION
BY MR. SCOTT:

R-Q. 142. Was that oil that was overflowing separating
from the rest of the pulp, or forming a part
of the froth?

A. No, it was all air bubbles.

(WITNESS EXCUSED.)

MR. SCOTT: Mr. Sutherland will be the next witness.

MR. GARRISON: If your honor will take the customary recess I think we can save a lot of time. We are not going to require these people to produce all of these assays. We usually take a recess about that time and it will be a very useful one now.

(Whereupon a short recess was taken.)

MR. GARRISON: We will admit without the necessity of proof that the statements appearing on exhibit 220 correctly represents the result of the assay weighing and so forth, which they purport to represent. Is that satisfactory, Mr. Scott?

MR. SCOTT: I think so.

David Douglas Punchon.

DAVID DOUGLAS PUNCHON, Called as a witness
in behalf of the defendant, being first duly sworn,
testified as follows:

DIRECT EXAMINATION

BY MR. SCOTT:

Q. 1. State your full name.

A. David Douglas Punchon.

Q. 2. What is your occupation?

A. Flotation foreman, Arthur plant, Garfield,
Utah.

Q. 3. It is your duty I presume to superintend ~~the~~
the operations of the flotation machines of your com-
pany?

A. Yes, sir.

Q. 4. Do you operate both the machines which
treat the slimes and also the ones which treat the con-
centrates and if not, which one?

A. I operate both of them, sir.

Q. 5. Have you ever operated—

A. That is, in saying "operate" I superintend all
the operators, that is during my shift, I don't operate
them personally but I see that they are operated.

Q. 6. Have you ever operated these machines with
an oil composed of a mixture of 39 per cent fuel oil,
10 per cent Jones oil, 10 per cent American creosote
No. 2, and one per cent Yaryan pine oil?

A. I have, yes, sir.

Q. 7. In the regular operation of the plant?

David Douglas Punchon.

A. Yes, sir.

Q. 8. And when so operating the plant and with that oil have you ever turned the oil supply completely off?

A. What machine do you refer to, the retreating plant?

Q. 9. Yes, sir.

A. Yes, sir.

Q. 10. I mean the one that retreats the concentrates.

A. Yes, sir.

Q. 11. You have turned off from the one that retreats the concentrates?

A. Yes, sir.

Q. 12. And what happens?

MR. GARRISON: This goes in under our general objection without the necessity of repeating it.

THE COURT: Yes. What is the object of this?

MR. SCOTT: It is to connect up with that 1,000 pounds of oil which was left in during this test and show what effect it would have.

THE COURT: This is all subject to the general objection. Of course it is a standing objection.

MR. SCOTT: What was the effect when you turned it off?

A. It would hold the cell in suspension—hold the mineral bound in the cell in suspension.

Q. 13. And just explain what you mean by that. I don't understand it?

A. That is it will hold the froth up.

Q. 14. Hold it up, you mean just suspend it?

David Douglas Punchon.

A. Suspend it, yes, sir.

Q. 15. Or stop it or what?

A. Just suspend it there. It will lose its action after a very short time. It won't displace for a moment but what it will lose its time there.

Q. 16. After a minute has passed, following the complete shutting off of the oil supply, state whether there will be froth or won't be froth in the spitzkasten?

A. It will gradually die away entirely in the spitzkasten, and cease to have any selective action whatever.

Q. 17. And how long before it dies away?

A. Well, sir, I wouldn't give it accurately, practically—the effect will take perhaps from a minute to five minutes you won't have no froth there.

MR. SCOTT: That is all.

CROSS EXAMINATION

BY MR. WILLIAMS:

X-Q. 18. When did you test this?

A. We have tried this several times in using our judgment on the oils.

X-Q. 19. And what was that under conditions where the circulating load was going around?

A. Yes, sir.

X-Q. 20. That was done under your present operations, using something over twenty pounds of oil to the ton of ore?

A. Yes, sir.

MR. WILLIAMS: That is all.

(WITNESS EXCUSED.)

Rex Sutherland.

REX SUTHERLAND, Called as a witness in behalf
of the defendant, being first duly sworn, testified
as follows:

DIRECT EXAMINATION

BY MR. SCOTT:

Q. 1. Please state your full name?

A. Rex Sutherland.

Q. 2. What is your position?

A. Flotation foreman.

Q. 3. Flotation foreman?

A. General flotation foreman.

Q. 4. Over all three shifts?

A. Yes, sir.

Q. 5. Where?

A. Arthur plant.

Q. 6. Mr. Sutherland, Mr. Punchon that just testified is foreman of one shift, isn't he?

A. Yes, sir.

Q. 7. And you are the foreman of the entire three shifts?

A. Yes, sir.

Q. 8. In operating the Arthur flotation plant, have you ever cut off the oil supply when using a mixture composed of 59 per cent fuel oil, 30 per cent Jones oil, 10 per cent American creosote No. 2, and one per cent Yaryan pine oil?

A. Yes, sir.

Q. 9. And what happened when you shut the oil supply completely off?

Rex Sutherland.

A. Why, your froth, you will have your froth just the same for possibly, I should say thirty seconds before you can notice it, in just the ordinary course of operations. Sometimes the elevator will stop and you won't have any oil going in there. Well, the operator will stand and watch that and he will immediately notice his froth die, won't have any agitation in the back and within—if he lets that go, within say three minutes there won't be any froth in the first cell at all.

Q. 10. The first, that is the head cell?

A. Yes.

Q. 11. And how about it down through the line?

A. Well, it takes longer to work down through there, goes right on down through the line.

Q. 12. How long before that condition spreads through the machine?

A. Well, I should say it would take ten minutes to go all through the machine before the froth would entirely disappear.

Q. 13. Well, do these statements that you are making apply to the slime flotation treatment or to the machines that are treating the concentrates?

A. The machines that are treating the concentrates.

Q. 14. The vanner concentrates?

A. Yes, sir.

Rex Sutherland.

CROSS EXAMINATION,

BY MR. WILLIAMS:

X-Q. 15. How recently have you made that sort of a test?

A. Well, we made them as they occur, several times, just in the ordinary course of operations.

X-Q. 16. And during that period in which you have been using more than twenty pounds of oil to the ton of ore?

A. Yes, sir.

X-Q. 17. You spoke of it as a result of the elevator breaking down. I don't quite understand it. Just explain it.

A. Well, something would break in the elevator, something like that.

X-Q. 18. What does the elevator do, the one that breaks under those conditions?

A. Well, that sends the oil into the machine.

X-Q. 19. Sends the ore?

A. The oil.

X-Q. 20. Oh, you have an elevator for oil?

A. Yes, sir.

X-Q. 21. And you were talking of the oil elevator?

A. Yes, sir.

X-Q. 22. And everything else in the plant will be running, middlings returning and so on, they will all be running the same, and when you stop the oil supply what you speak of happens, is that right?

A. Yes, sir.

Samuel P. Sadtler

RE-DIRECT EXAMINATION,

BY MR. SCOTT:

R-Q. 23. Were middlings being returned? Did you have a circulating feed at that time, the time the oil was completely off that you testified about?

A. Yes, sir, during the regular course of operations, we have the middlings returned.

WITNESS EXCUSED.

DR. SAMUEL P. SADTLER, recalled, testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 593. Dr. Sadtler, you have heard, have you, the description of these operations at the Arthur plant that Mr. Janney testified about with 323.78 pounds of oil per ton of ore?

A. I heard Mr. Janney's testimony.

Q. 594. Will you compare that operation with the disclosure in each of the following: The Everson patent, the California Journal of Technology, the Kirby patent and Froment, as to the following: I would like a comparison made as to the powdering of the ore, its admixture with water, the addition of oil and agitation?

A. The first in order of these disclosures of course is the Everson patent. In the Everson patent we have

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covered first of all on page 1 of the Everson patent as part of the Everson invention: "A fat or an oil either animal, mineral or vegetable." That is broad enough to cover any admixture of oils or fatty oils, essential oils or any constituent or derivative from paraffin, or any mineral oil, irrespective of the question as to whether it may be totally insoluble. We have then the presence of acid, either mineral or vegetable acid used. Now, passing to the process indicated in the Everson patent, we have the second and third steps, as I termed them before, the first step being that operation wherein the acid and the oil were mixed and allowed to stand together for a time before adding that mixture to the oil. I leave that to one side and turn to the second step of the Everson patent in the use of petroleum or a liquid constituent thereof like paraffin oil, and then the third illustration of the Everson patent. It is stated clearly: "It is also not essential to my invention that the acid or salt employed with a vegetable oil be added to the oil before the incorporation of the oil with the ore, as it is entirely practicable, at least in most, and possibly in all, cases, to first mix such oil with the ore and thereafter add the acid, as set forth in the use of petroleum." That makes the method which was described more fully in connection with the use of petroleum available and extended to the use of any of these types of vegetable or animal oils, but at all events to vegetable oils, and that of course includes the fixed oil

P. 3856, L. 8, insert " the essential oil may be in part
soluble or not," after " whether "

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Everson contemplates the operation as described more fully under petroleum as applying there also.

Now, we have in the Everson patent the pulverization of the ore, finely powdered, "the reduction of the quartz or other rock containing the mineral to a powder," reducing the mineral to a comminuted state as described on the first page, and then we have in this second or third process the mixing of the finely powdered or comminuted ore with the oil. Everson gives an example in which 17 per cent was used. That is an example and is not binding, but well known, as I indicated.

Then we have next in the practice the concentration, after thorough agitation of the mass. That is the agitation step, which is applied in a small way or applied in a large way, and was the agitation step of the Utah practice. And the detachment of the sand, which means the separation of the gangue, and next: "Will in this case be preferably removed by means of a constant overflow of water from a washing-out vessel, by which overflow the concentrate will be floated off."

That represents the steps of the process, what takes place on the spitzkasten, and represents the passing off of the froth or of the mineralized ore froth. The amount which was used, as I understood Mr. Janney to say, was 323. and a fraction pounds per ton. That is very close to 16 per cent, 16 per cent of oil or oil mixture practically was used in that case. That is very close to the 17 per cent of Everson and

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practically is in the same class of operation with the amount of oil.

Passing next to the Kirby patent, we have in the Kirby patent, coming as late as—his application of December 14, 1903—we have in the Kirby patent the finely pulverized ore or mineralized matter, enough water to make with the same a floating pulp and then either kerosene or “a solution of bitumin in a thin distillable hydrocarbon liquid, as kerosene” and these mixed so thoroughly, agitated together so thoroughly “as to finally subdivide said solution into small globules into contact with substantially all of the pulverized mineral particles which will, by preference, adhere to them.” And, following that: “In allowing the hydrocarbon-coated particles to float to the surface of the mass.” Now, that first step of the Kirby process is the exact counterpart in principle, as I will point out in a minute in some details, with the large scale ~~process~~ ^{process} which was carried out and described by Mr. Janney. In the first place, in this Kirby process we have an efficient agitator—agitation shown and with rapid agitation, “Violent agitation” in fact the claims say, in the first or mixing vessel. That is the type of the mixing mechanism which was used in the experiment described by Mr. Janney. At the time of this Kirby application there were mechanisms, as testified before. There were other forms of efficient mixing apparatus known, distinctly two in number, the Johnson mixer and the Gabbett cone mixer. So that there was available a mixing apparatus ex-

P. 3858, L. 13, insert " and bring said globules " after
" les "

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actly of the same mechanical type as that which was used in the large scale operation at the present time. All of the principles necessary to produce the froth were here indicated as the illustration of efficient agitation.

Turning to the Froment. In the Froment description and the Froment machine we have also a form of agitation which is quite efficient. That is the revolving oval, the oval forms of rotating blades which rotate in opposite directions and thereby create strong or really thorough agitation and entrain air and produce a froth in the presence of the proper amount of oil with the floating pulp and the presence of mineral sulphide particles; this froth is stabilized so that we have the production of an efficient froth as a step shown in that Froment description and the Froment patent in the first of these vessels of the Froment patent, called the mixer in the Froment description, all of the principles are the same there, their production of a froth as in the practice in the large scale. The froth in the case of the Froment description is carried off into a second vessel and there is supplemented by that acid treatment using some calcite, but that is cited as a secondary step and does not bear upon the main feature of the mechanism, and the application of the principles necessary to produce a froth.

In the case of the California Journal of Technology, we have no machinery. We have only the showing of an efficient froth, of getting the foam effect, as

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it is called; but in the getting of this foam effect we have the principle there of the flowing ore pulp and the small amount of oil, and that was smaller than was referred to in this other case, the 17 per cent of Everson, 25 per cent to 75 per cent of Kirby and the 16 and a fraction per cent as practiced in the Utah experiment. And then the violent agitation, and with these elements which are the same in all of these cases we get the mineralized froth of the California Journal of Technology when we used a modern—when we used a form of mechanical agitator which was however abundantly known at the time of the California publication, that is, the Gabbett cone mixer, which was patented in 1889 already, which we used then in the experiment that still stands there for illustration of the California Journal of Technology proceedings, we got a fine froth, mineralized froth.

So that in all four of these publications stated, and belonging to the prior art, we have a clear statement of all the principles involved in the raising of a froth as practiced by Mr. Janney using 323 pounds of oil mixture to the ton of ore, approximately 16 per cent.

CROSS EXAMINATION, BY MR. WILLIAMS:

X-Q. 595. Do you regard this operation by Mr. Janney as the carrying out of what you have discovered to be the three methods—to be the third method of the Everson patent?

A. It would come under that clause rather than

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under the second because his mixture was largely—well, it would be a mixture of oils, oil—all of them covered clearly by Everson in her statement—covered clearly by Everson in her patent. That is as I understand her: He had some fuel oil, had some pine oil and that goes into the two classes of paraffin product and vegetable oil. But as the process described in Everson is equally applicable so stated by Everson, I see no reason why we should not use a mixture.

WITNESS EXCUSED.

BEN H. DOSENBACH, recalled, testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. In the Butte & Superior flotation plant is there any difference in the level in the pulp in the roughers and cleaners? Any difference in the point at which the froth is taken off?

A. Yes, there is a difference.

Q. 2. And what is the difference?

A. The level of the pulp in the rougher cells is carried much higher in the spitzkastens than it is in the cleaner. That is the lower portion of the froth is much higher in the spitzkasten in the cleaner than it is in the rougher cells.

Q. 3. And what is the reason of that?

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A. The object being to take off the froth to the cleaners only without any of the pulp, and the object in the rougher cells being to take off as much as possible but not so high a grade, in order to make the recovery.

Q. 4. I would like to have you look at the California Journal of Technology a minute and tell me what you understand by some of the terms. Now, under that tabulation of experiments which occurred after the heading "test—molybdenite ore" we find the first paragraph relating to tests 1, 2 and 3, then the next paragraph relating to test 4, 5 and 6, and the statement is made: "This method gives the highest grade of concentrate of any of the direct treatment here outlined." The word, "direct" I wish to call your attention to that. Then, in the following paragraph "But these concentrates were not marketable. In practice they would have to be reconcentrated" and the word "reconcentrated" and then one of the columns in the table above is headed "number of treatments." Now, I would like to know your understanding as a metallurgist of the significance of that term "number of treatments" at the head of that column, and of the word "reconcentrated" and the word "direct"?

MR. WILLIAMS: I object to the testimony of this witness in explanation of the column headed "number of treatments" because he has not qualified, either by a study of the document as a whole or by knowledge of the meaning of terms in the days of this invention so as to enable him to testify as to what this

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means. So far as the meaning of the word "re-concentrate" and I think something else is concerned, I see no particular objection to that, but it seems to me the witness has not qualified to express an opinion on this matter.

MR. SCOTT: Maybe I can qualify him.

Q. 5. Have you studied this article in the California Journal of Technology?

A. I have.

Q. 6. Have you performed operations that you considered to be in conformity with the directions contained in that article?

A. I have.

Q. 7. I think you qualified before as to your scientific education and experience, did you not?

A. I did.

MR. SCOTT: I submit, your honor, that with the qualification of this witness he is in a position to impart information to the court and ourselves as to the meaning of technical terms.

THE COURT: Well, is there any difference between the way these terms were used in that day and this?

MR. SCOTT: I know of no difference.

MR. WILLIAMS: I don't believe the witness does. That is the difficulty.

MR. SCOTT: Well, the test is as to his understanding of these words.

MR. WILLIAMS: His knowledge commenced in

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MR. SCOTT: Well, the article was written in 1903.

THE COURT: Well, the presumption runs forward a little I consider so now it may run backwards a little. I will allow him to answer. The objection will be overruled.

A. Experiments Nos. 4, 5 and 6 as stated in this article show the results obtained by treating separate samples with small quantities of oil and in a small solution, agitated violently to produce the foam effect. Now, this article says this method gives the highest grade concentrate of any of the direct treatment here outlined. I would say that means that it is a comparison of the results obtained between the three experiments when a small quantity of oil was used. Then further along in the experiment No. 6, 10 c.c. of oil was used for 100 gms. of ore. It states the recovery as being 75 per cent and the concentrate 32.4 molybdenum sulphide. It also states that the concentrates were not marketable; in practice they would have to be reconcentrated. That means that the concentrate produced by the initial treatments were not of sufficient value to be marketable and would have to be retreated again in order to obtain a proper grade. Consequently the description of a retreatment of the concentrates follows in the next paragraph.

Q. 7½. Well, with this—would this reconcentration referred to here correspond to what you call “cleaning”?

P. 3864, L. 16, insert " large quantity of oil was used and
the three experiments when a " after " a "

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A. Yes, it would correspond to what we call cleaning.

Q. 8. Now you did not tell us your understanding of the head of that column, "Number of Treatments."

A. I was just going to. In the fifth column, under the head "^{don}Molybdenite," setting forth the various steps in the experiment that were performed, the heading of the fifth column is abbreviated but I take it to mean number of treatments. I should say that the number of treatments in this column means the number of times the process was carried out and the number of times the concentrate was removed, which corresponds directly to the operations in flotation, wherein a number of cells are used to constitute a flotation unit.

Q. 9. Do you remember, or did you make a record of the speed of the revolutions of this Fryer Hill machine in which you made a demonstration in court the other day?

A. I think I stated the speed.

Q. 10. Do you remember it now; I don't remember whether you stated it or not.

A. From fourteen to fifteen hundred I think it was; I am not positive without looking over the record for that day.

Q. 11. In the Butte & Superior plant I think the witnesses have stated that sulphuric acid is used. Will you state where that is added to the pulp?

A. In practically all of the operations the acid is usually added to the feed before it enters the flo-

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tation plant; that is, there is a time which elapses between the time the acid is added to the feed going to the flotation plant and when the feed enters the flotation plant.

Q. 12. How much time do you suppose; a matter of minutes or hours?

A. Well, it might be minutes and it might be hours, all depending on the circuit. I should say it would be possibly fifteen or twenty minutes.

CROSS EXAMINATION,
BY MR. WILLIAMS:

X-Q. 13. In the California Journal of Technology as I understand it, the operations were carried on, as far as molybdenite ore was concerned, in percolating tubes, weren't they?

A. They were.

X-Q. 14. Do you understand what the number of treatment means as applied to those experiments, that were clearly Elmore experiments, Nos. 1, 2 and 3?

A. I would take them to be the same as the other experiments following, 4, 5 and 6.

X-Q. 15. They also were carried on in the Elmore process in these percolating tubes. Tell me what the procedure was.

A. The oil may have been taken off; I don't know the method.

X-Q. 16. Start at the beginning.

A. Beginning on page 35 of this article it gives the conditions of the various experiments that follow.

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and it gives the laboratory method for conducting the tests. There are two different ways of mixing, which is stated on page 36. One is by agitation, thorough agitation, and the other is by very gentle agitation, the oil being kept in a single lake and broken up as little as possible consistent with a thorough contact of the pulp and oil, which describes the Elmore procedure, and the following describes the agitation and formation of a froth procedure which states that—It states that each method has its advantages and disadvantages. Now it says, directly following that: "The mineral laden oil was then skimmed off with an aluminum ladle." And it goes on to state why aluminum was used and the comparison between aluminum and glass, and I take that to be an accurate description of how the mineral laden oil was removed. It says it was skimmed off with an aluminum ladle, and down below in this table that I was referring to, it says "Number of Treatments." So consequently I would take it that it was treated again.

X-Q. 17. As you read it there it says "The mineral laden oil is then heated and treated in the centrifugal separator as above described." Does it not?

A. That is a correct reading of one of the paragraphs of this page, yes.

X-Q. 18. And that immediately follows a repetition of that description of the methods of agitation, one by inverting the tube, two by rotating the tube, three by violently shaking the tube; and then the statement that the charge having been thoroughly mixed, the

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tailings were allowed to settle, the solution is added through the oil on top of the tube, the concentrate being floated off as shown in Figure 26. That is right, isn't it?

A. No, that paragraph describes three methods of mixing by agitation, because there is one which is inverting the tube several times, and another by rotating the tube and another by violently shaking, which is differentiated some from the first two.

X-Q. 19. But that paragraph describes just three methods of mixing?

A. Yes.

X-Q. 20. Then it proceeds to tell you what is done after the mixing, doesn't it?

A. Yes.

X-Q. 21. And we find the mineral laden oil is heated and treated in a centrifugal separator. Isn't it reasonable to assume that the men who described these experiments told you what they did, and that when they say they do something, that they did do it, therefore, that they did it by those three methods?

A. No, I could not interpret it that way.

X-Q. 22. Now, let us return to the table itself. The first, No. 1, we have 2400 grams of oil and 2000 grams of ore; that is the largest amount of oil of all of the experiments isn't it?

A. Yes.

X-Q. 23. Now, we find there were four treatments; now you know that in the Elmore process that is just what they do, and that is what these men say they

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did; they take the concentrate, float it off, and treat it in a centrifugal separator, and separate the oil, and then they put the oil back again and see what more they can do with it; isn't that right?

A. In the Elmore, yes.

X-Q. 24. And they have succeeded by that means in getting four different treatments; that is a reasonable interpretation of what it means, isn't it?

A. Yes.

X-Q. 25. The next column we have 2000 grams of oil and 2000 grams of ore; that is a little less oil, and they only got three treatments. That would be treatments of the kind that they have spoken of here, would they not?

A. They would.

X-Q. 26. The kind I have mentioned?

A. Yes.

X-Q. 27. The last one of the Elmore, we have a thousand grams of ore and 1200 grams of oil, and there there are three treatments. That would be the same kind of retreatments I have described here, would they not?

A. They would.

X-Q. 28. And now we go down to experiment No. 4, where there was 2.4% of oil, and there was only one treatment. That would indicate, would it not, that they were not able to get enough oil out of it to start over again?

A. No, I don't say that that would indicate that they could not get enough oil out of it, because the

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next one follows with two treatments, and the next one with three.

X-Q. 29. And that second one had twice as much oil—more than twice as much?

A. Yes, it had.

X-Q. 30. And the next one had almost three times as much oil, or a little more than three times as much oil, 8.9%, and there you get three treatments; now, isn't it reasonable to assume that since the number of treatments correspond with the amount of oil, that the students did the same thing with their smaller quantities of oil that they did with their larger quantities of oil?

A. I can not conceive how they could get the oil out of the concentrate on that experiment No. 4, wherein 2.1% of oil was used, and I agree with you that if there was not enough oil when they were using 2.1% to get it out, then they did not make any more treatments because the oil was not perceptible, possibly.

X-Q. 31. Your theory as I understand it was, that they shook the ore and oil in a percolating tube and took off the concentrate, and then they shook it again in the percolating tube and took off the concentrate, and then they shook it again; is that your theory?

A. That is not specifically stated, that they did that; it might have been according to your theory of adding more oil, and it might have been that they shake it over and over again. It can be taken both

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ways in this. And even if it was with more oil, it shows the betterment of the recovery.

X-Q. 32. A reasonable interpretation of that would be that in the 5.3% experiment where they had two treatments, that they agitated the tube, formed the froth, and then added the same kind of oil and agitated again and took off that froth; that would be the two treatments on your theory?

A. That is one way according to my theory; the other way is that they agitated once and took off the froth, and agitated again and took off the froth; that is one way that they might have carried out the operation, and the other way that they might have carried out the operation.

X-Q. 33. As a matter of fact you are not certain what those students meant when they were writing this description of their laboratory operations with nothing before them except the Elmore process to guide them; that is true, isn't it?

A. Well, they had the Everson; they stated back here that they had the Everson to guide them in a way.

X-Q. 34. You notice that they do not speak of the Everson as a frothing process, don't you?

A. They speak of the Everson as bringing forth the use of acid, and give her credit for the use of acid in the processes of separation. Then they themselves, I think, must be given a great deal of credit for froth flotation, because they mention the word froth, and they mention agitation, and float, and I can not see any other way but what they themselves must be given a

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great deal of credit for the production of a mineral froth.

X-Q. 35. I am not discrediting the ingenuity of the students, but I am trying to make out whether you can be sure as to what they meant when they said the number of treatments, 1; number of ^{re}treatments, 2; number of treatments, 3, in this printed document. You are not sure whether in their treatments they added oil or whether they omitted to add oil, are you?

A. I am not sure about that; as I stated before, it can be taken both ways. If there was sufficient oil present that they could obtain from the concentrate to put back again into the next agitation procedure, then that operation could be carried on that way. If that was not possible, they did not do it that way.

X-Q. 36. But you can not be certain as ^{to} what my interpretation of it is.

X-Q. 37. And you don't know which one they did?

A. Which one of them, that may be correct.

X-Q. 38. Now, you were to let me have a flow sheet of the Butte & Superior mill as it was operated in the presence of the plaintiff's representatives.

A. I have prepared a flow sheet for you, Mr. Williams, according to that.

X-Q. 39. Suppose you describe it as briefly and clearly as you can.

A. The flow sheet as represented upon this tracing, is very similar to the one previously described by me in court, with the exceptions that there are several changes, which I will note. On Sunday, April 29th,



P. 3872, L. 17, insert " which way they did it ? A. I give
two statements " after " certain "

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there were seven pyramid roughing cells in operation, which are numbers 1, 2, 3, 4, 5, 6 and 7. The number 8 pyramid machine was in operation as a cleaner unit, and was used to clean the concentrate from No. 1 cleaner, which is this cleaner that I am now referring to. Now, the four middling cells on one side of the pyramid machine, or on one side of the agitating cells were blocked off, so that none of the froth was taken off in those spitzkasten. That is what occurred for all of the pyramids with the exception of No. 5. No. 5 was open on both sides; it shows here to be closed, but I have just made several crosses here and notation, denoting that these four cells were open in this pyramid machine.

X-Q. 40. When you say blocked off, you mean the entrance to them was closed so that no liquid could get into them?

A. The duct from the agitating cells to the spitzkasten was closed, so that there was no circulation or no pulp flowing through these four spitzkasten. That was the condition of the pyramids, as I have said, with the exception of No. 5 pyramid. Now, the flow through the plant was substantially as described before, with the exception that of the middling cells, which constitute four of the later pyramids—

X-Q. 41. The last four?

A. The last four of the pyramid cells—it was only taken off on one side. This cleaner, which we will call No. 1 cleaner, was the first cleaner, and to it was brought the rougher concentrate produced by the first three cells of the pyramid machine. The concentrate

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from No. 1 cleaner was pumped up to No. 2 cleaner, producing on the first three cells a second cleaner concentrate, which was elevated to No. 3 cleaner, which produced a final concentrate. The last four cells on one side of the second cleaner produced a lower grade concentrate, which went to the No. 1 cleaner, and again through the circuit up to No. 2 cleaner. The tailing from No. 1 cleaner went back as a middling. The tailing from No. 2 cleaner went out to waste as a discarded product. The tailing from No. 3 cleaner went back to No. 2.

X-Q. 42. Now, these cells, 4, 5, 6 and 7 of the No. 2 cleaner, were they provided with the pneumatic attachment that characterizes what is known as the Janney mechanical pneumatic machine?

A. They were.

X-Q. 43. That is true of course; ^{of all} ~~they~~ are the pyramid machines.

A. In all of the pyramid machines the last four are provided with the pneumatic equipment.

X-Q. 44. Now, in the operation of No. 2 cleaner the pulp flowed successively to it from spitzkasten to spitzkasten in the usual way?

A. It did.

X-Q. 45. And of course in your pyramid machines, they flow down by gravity?

A. They do.

X-Q. 46. From spitzkasten to spitskasten?

A. Yes.

X-Q. 47. Now, in the No. 1 cleaner, did the material

P. 3874, L. 5, insert "The No. 3 cleaner produced a
finished concentrate" after "concentrate."

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treated flow from spitzkasten to spitzkasten in series?

A. There is practically only one spitzkasten for that cleaner.

X-Q. 48. That is to say the partitions between the spitzkasten do not extend down very far, do they?

A. They do not.

X-Q. 49. How far do they extend down below the top?

A. About ten or twelve inches.

X-Q. 50. Then below that on both sides it is all one large spitzkasten, is that right?

A. Yes.

X-Q. 51. Then No. 2 agitator for No. 1 cleaner, where does it draw its supply of material to be agitated?

A. From the spitzkasten.

X-Q. 52. And that is true all along the line there?

A. It is.

X-Q. 53. How about No. 3 cleaner?

A. That is the same as No. 1 cleaner.

X-Q. 54. Then in the No. 3 cleaner the spitzkasten are entirely separate in each cell—the spitzkasten for each cell is separated from the spitzkasten for the other cells?

A. No, it is just like No. 1.

X-Q. 55. That is to say, it is all one general spitzkasten?

A. Yes.

X-Q. 56. Now, was that arrangement an arrangement made on that day, or how long had it continued?

A. That had been made for—that had been running

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that way for—well, the last time I was up to the plant was several days before then, and it was running then, but I did not give it any general inspection because I was busy down here; but we have run this many times like that before, and it has been arranged several months ago to use this No. 8 pyramid as a cleaner. There was no special arrangement made for any part of the operation on Sunday.

X-Q. 57. In your No. 2 cleaner, and I think in all your pyramid machines, I observed a substantial difference in the top of the spitzkasten between the cells Nos. 1, 2 and 3 and Nos. 4, 5, 6 and 7. Suppose you describe that difference.

A. Well, that is due to the fact that the spitzkasten of cells No. 1, 2 and 3 are deeper than the spitzkasten for 4, 5, 6 and 7, and the construction was placed that way.

X-Q. 58. You have not described it.

A. The first three cells are mechanically agitated only. The last four cells are mechanical and air, consequently it is not necessary to have as deep a spitzkasten for mechanical and air as it is for straight mechanical.

X-Q. 59. I notice that your flow was restricted as it came out of cells 4, 5, 6 and 7; that the sides of the top of the spitzkasten approach together so that the overflow was quite restricted; that is the construction, is it not?

A. It is.

X-Q. 60. Whereas in 1, 2 and 3, they are of the full

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width throughout and the overflow lip was the full width of the spitzkasten?

A. That is correct?

X-Q. 61. Then in cells 1, 2 and 3 you have a mechanical arrangement somewhat resembling a paddle for pushing the concentrate over the lip?

A. That is correct.

X-Q. 62. And in cells 4, 5, 6 and 7 it rushed off the restricted lips without any assistance?

A. That is right.

X-Q. 63. Now, you used your mechanical arrangement for pushing the concentrate over the lips in Nos. 1 and No. 3 cleaner, do you not?

A. That is correct.

X-Q. 64. Can you tell me why ^{it} ~~that~~ is that the spitzkasten for all the pyramids except No. 5 were put out of action?

A. That was done to relieve the elevators, and to reduce the middling that was returned back for circulation and retreatment. It reduced the load approximately one-half.

X-Q. 65. Now, as this plant was operated on Sunday in our presence, what was the place of the oil feed of the plant; is that shown?

A. It is shown substantially the same as on my previous flow sheet.

X-Q. 66. Marked "oil feed"?

A. Marked "oil feed."

X-Q. 67. And that—at that oil feed the oil was fed in hot, was it not?

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A. Well, I should say warm; warm enough to keep it plenty liquid.

X-Q. 68. You have a steam heating arrangement in your oil mixer, have you not?

A. It is absolutely necessary, yes, sir.

X-Q. 69. Have you any figures as to the temperature at which the oil goes into the plant?

A. I have not, off-hand, no.

X-Q. 70. And the water as it flows through the plant is quite cold, is it not, and you do not heat that at all?

A. We take the chill off of it at times.

X-Q. 71. You were not on Sunday last taking the chill off of it?

A. I don't remember what the temperature was Sunday; it might have been about 14 or 16 or 18 degrees. We don't make any particular effort to heat it or not heat it, only on cold nights we can not allow the cold water to run through.

X-Q. 72. You don't want it to freeze?

A. No, I should say not.

X-Q. 73. Therefore you guard against freezing?

A. Yes.

X-Q. 74. Have you got with you the mill reports of operations of the plant on Saturday the 28th, Sunday the 29th and Monday the 30th of April?

A. No, I haven't brought those with me.

X-Q. 75. Will you bring those reports—I believe I asked you to bring some other reports, did I not?

A. Yes.

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X-Q. 76. Have you them with you?

A. Yes. I might say that these reports of the operation on Sunday are being prepared and I think will be finished some time tonight; and possibly the men who are preparing them now will have them finished in time to submit them tomorrow.

X-Q. 77. Could you include the day before and the day after?

A. I will do so if you desire.

MR. SCOTT: I offer the flow sheet in evidence produced by the witness, as representing the operations on Sunday, April 29th, 1917.

Flow sheet admitted in evidence marked DEFENDANT'S EXHIBIT No. 222.

X-Q. 78. What are these records which you have brought and are now exhibiting; when do they commence?

A. They commence prior to September 30th, 1913, and as I understand it you wished some one day, November 1st, 1913, or October 1st?

X-Q. 79. Well, let us take September 30th, 1913. Give me the ore milled, what is that figure?

A. The ore milled on September 30th, 1913, was 3,308 tons.

X-Q. 80. And that was the total amount of ore milled in the plant, was it?

A. That was the total amount of ore milled in the entire mill.

X-Q. 81. So that a part of that ore went through the water concentration, and some concentrate was taken

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off, and the balance of it went to your flotation plant, is that right?

A. Exactly so.

X-Q. 82. Now, give me the amount and grade of concentrates in the wet concentration plant for that day.

A. It is impossible to give it to you for that day, because I have no record of it. I have a record of the assays, but as to the amount, I can not differentiate from what is produced in the flotation, only an estimate; but the average zinc concentrate I can give you.

X-Q. 83. What is the zinc produced in, tons; is that the total of the plant?

A. Yes.

X-Q. 84. How much is it?

A. 505 tons.

X-Q. 85. And the lead concentrate produced?

A. Six tons.

X-Q. 86. General heads, moisture percentage?

A. 2.0%.

X-Q. 87. General head, lead?

A. 1.2%.

X-Q. 88. General head, zinc?

A. 21.9%.

X-Q. 89. General tails, lead?

A. .18%.

X-Q. 90. General tails, zinc?

A. 4.1%.

X-Q. 91. Zinc concentrate, lead?

A. 1.9%.

X-Q. 92. Zinc concentrate, zinc?

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A. 50.3%.

X-Q. 93. Lead concentrate, lead?

A. 48.4%.

X-Q. 94. Lead concentrate, zinc?

A. 17.2%.

X-Q. 95. Indicated recovery?

A. 88.59%.

X-Q. 96. Apparent extraction, zinc?

A. 88.50%.

X-Q. 97. The item of estimated recovery is not filled in under the day; is that right?

A. That is right; it is not filled in for the particular day, as we keep the apparent estimated recovery up to date, for the whole month, to date, from day to day.

X-Q. 98. Give me the figures of the flotation output in shifts.

A. The flotation concentrate assay by shifts was for the first shift, 49.5% zinc; for the second shift, 48.3% zinc; for the third shift, 50.8% zinc.

X-Q. 99. And isn't there a separate figure for the water concentrate?

A. Yes.

X-Q. 100. Read that.

A. The zinc produced in the water concentration end of the mill for the first shift assayed 52.3% zinc; for the second shift, 51.8% zinc; for the third shift, 50.6% zinc.

X-Q. 101. Is the total of the concentrates given?

A. No, only as a total, the combined flotation and mill zinc?

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X-Q. 102. What is that?

A. 505 tons.

X-Q. 103. Now the amount of oil used, read that by shifts.

A. I haven't got it by shifts, but the oil used on that day was—I don't know whether that figure is right or not; it says 13.79 pounds of oil per ton.

X-Q. 104. BY THE COURT: Was that after December 26th?

A. No, this was September 30th, 1913. It says on that report that there was 18,044 pounds of oil used that day.

X-Q. 105. Let's see how many were used the next day.

A. Well, the day previous, I see the report says there was 1,742 pounds used.

X-Q. 106. And the percentage of that was what?

A. 1.676 lbs. per ton.

X-Q. 107. Take the day ahead, September 28th.

A. The amount of oil used on the 28th was 1,800 lbs., or 1.751 lbs. per ton.

X-Q. 108. Aren't you inclined to believe that there is a mistake in the return for September 30th, 1913?

A. Well, I have not looked at this thing for a long while, and I just got these reports out.

X-Q. 109. I will ask you to check it up over night, if you will.

A. Very well.

MR. SCOTT: If the court please, I would like to have the record show that we invite plaintiff's repre-

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sentatives to witness a repetition of the test with 323 lbs. of oil, that Mr. Jan^y testified to, and we will be willing to do it on Sunday next or any other Sunday or any other time that will be suitable and agreeable.

MR. GARRISON: At your plant here?

MR. SCOTT: At Salt Lake City, or at Garfield.

MR. GARRISON: Oh, no, that is unreasonable.

THE COURT: The record may show it; I don't know how much weight we will attach to that kind of an offer. It might be in Alaska next time.

MR. KREMER: If your honor please, I have got here the answer to the plaintiff's bill as amended, and I have also an answer to the supplemental bill of complaint. Under the rule, notice was given by counsel that the portion of the amendment as embodied in the application to file the supplemental and amended bill, was noticed to become a part of the original bill, and under the rule, giving page and line; therefore it automatically became incorporated in the bill as amended. For that reason we have prepared a separate answer to the original bill as amended. That left the supplemental bill, having expunged from it paragraph 8, that having become a part of the original bill, and we now file an answer to that. In this connection I will state to the court that we expect to close our case tomorrow, and I have endeavored to have these answered prepared—I asked your honor if we had all day tomorrow, but I thought it better to have them prepared so that counsel would have them before we close our case. They have very kindly consented that if there is any mistake in the

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transcribing from the original pleadings heretofore filed, that we may have permission to make corrections of those things.

MR. WILLIAMS: Yes.

MR. KREMER: I thought it would be better to give them an opportunity to examine them over night, before we close our case.

Whereupon further hearing was adjourned until Saturday morning, May 5th, 1917, 10 o'clock a. m.

Saturday, May 5, 1917, 10 a. m.

MR. DOSENBACH

CROSS-EXAMINATION RESUMED

BY MR. WILLIAMS:

X-Q. 110. At the close of the session yesterday you observed that the record for September, 1913, seemed to contain an unusual amount of oil, and I asked you to check that up over night. What have you learned in regard to that?

A. As far as I could get any more information on that matter—I endeavored to find out just why there was a difference between the 30th and the 28th in the amount of oil per ton of ore, and the only thing that I could find was, it being the last day of the month. I could not find any records wherein it showed any real

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reason for its not being what it is, other than the last day of the month.

X-Q. 111. That is to say, a sort of accumulation of the errors of the month, to check up the total month's consumption?

A. Yes.

X-Q. 112. Let us have, then, the average for the month.

A. The average for the month was 2.799 lbs. per ton of ore milled.

X-Q. 113. Does this record show the character of the oil?

A. This record does not show the character of the oil.

X-Q. 114. Now, turn back to the last day of August. What was the record on that day as to oil used per ton of ore milled?

A. The record for August 31st, 1913, shows 2.561 pounds of oil per ton of ore milled.

X-Q. 115. And the record for the preceding day, August 30th, 1913?

A. It shows 1.237 pounds of oil per ton of ore milled.

X-Q. 116. On the date ahead of that?

A. 2.470 pounds per ton of ore milled.

X-Q. 117. I notice that on September 30th there is no acid determination; what does that mean?

A. Well, there was possibly some reason for it; I don't know what the reason might be. It is not on here for September 30th.

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X-Q. 118. But for September 29th you have an acid determination?

A. Yes.

X-Q. 119. What is the proportion of acid?

A. The amount of acid is 8.065 pounds per ton of ore milled.

X-Q. 120. Now, on August 31st, 1913, what was the acid?

A. 2.139 pounds per ton of ore milled.

X-Q. 121. August 30th?

A. 7.364 pounds per ton of ore milled.

X-Q. 122. And the average for the month of August was 5.816 pounds per ton of ore milled.

X-Q. 123. Now, you have said that the record does not show the character of oil that was used then, but I believe you are acquainted with the fact, are you not?

A. I think I have stated before that during this period two oils were used, the pine oil and oleic acid.

X-Q. 124. In August, 1913, you have an item "Copperas, Pounds, and Lime." That is the sum total of the copper sulphate and lime used?

A. No, that is lime only. This was not scratched out. We used no copperas then.

X-Q. 125. What was the amount?

A. The lime used was .373 pounds per ton of ore milled.

X-Q. 126. August 29th, I see also is it copperas, pounds, and lime.

A. Well, it is lime only, because we did not use any copperas then; it was lime.

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X-Q. 127. And the amount?

A. .363 pounds per ton.

X-Q. 128. THE COURT: How long did you testify that the conditions of this flow sheet you exhibited had prevailed?

A. The one I testified to yesterday?

X-Q. 129. THE COURT: Yes.

A. Why, that has prevailed for the last two or three months. Previous to that, while the machines were of different construction and differently placed as to the relation of one cell to another, there being three machines before and eight machines now, however the three machines had a greater number of cells than each one of the eight has now; but they were the same machines that had been in use before only arranged differently as to the position of one to the other.

X-Q. 130. MR. WILLIAMS: Now, have you the reports of the operations on Sunday, April 28th?

A. Mr. Shimmin has the reports for that and he was to be here at ten o'clock this morning.

X-Q. 131. And you haven't them?

A. No, I haven't them; I haven't had time to make them up personally.

X-Q. 132. I asked you for an analysis of the copper sulphate that you received from the Anaconda Company, have you that?

A. I think I have that in my notes upstairs, in one of my notebooks. I did not remember that I was to furnish that, but it will take only a minute to give it to you.

X-Q. 133. You were to give me an early analysis of

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the zinc in the total feed to the plant, including the circulating load. Have you that?

A. As I remember you asked me for December and November, 1906, and also for December, 1915, so I wish to say that the average for the month of December, 1915, showed 12.16 per cent zinc.

X-Q. 134. And this was the amount of zinc in the total feed, including the new feed in the circulating load, is that right?

A. That is right. Then for November, 1916, the amount of zinc in the feed, including the middlings, was 11.9 per cent zinc.

X-Q. 135. And for December, 1916?

A. The amount of zinc in the flotation feed, including the middlings, was 12.5 per cent zinc.

X-Q. 136. And as to all three of these months the variation up and down from that average was very slight.

A. It was.

X-Q. 137. You were to give me an analysis of the molybdenite ore that you used in the experiment in court. Have you that?

A. I haven't them, Mr. Williams, because it has not been finished yet.

X-Q. 138. Now, in regard to September 30th, 1915, is there any showing on the record of the temperature in the flotation plant?

A. On December 30th?

X-Q. 139. September 30th, 1915?

A. No. And to get that I can give you approximate.

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ly the temperature which we were operating at that time.

X-Q. 140. What was it?

A. About thirty to forty degrees centigrade, somewhere along in there.

X-Q. 141. And when was the introduction of heat or the heating of the pulp eliminated?

A. We eliminated it quite a number of times, but we always kept a little steam there to take the chill off the water, especially in the winter time. But up to 1915, the middle of 1915, say, we used more steam than we did after that time.

X-Q. 142. Well, what were the temperatures prevailing in the plant in December, 1916, before December 22nd, 1916?

A. Before the 22nd of December, 1916, the temperature was about 35° or 36° C.

X-Q. 143. Now, since December 22nd, 1916, what have been the temperatures of the pulp?

A. From 14 to 40° I should say, but at the present time averages close to 14 and 18 degrees; closer to that than the higher temperature.

X-Q. 144. Was there any particular reason for so large a range of temperature?

A. The only reason was that we tried out a high temperature at various times and a low temperature at various times and found it was not necessary to use any higher temperature than we were using.

X-Q. 145. So that you have come down to this low temperature of fourteen or fifteen degrees centigrade as the best temperature to work at?

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A. Well, at this time, yes.

X-Q. 146. What methods are used at your plant for the determination of the amount or character of oil in the different products?

A. Well, I am not in a position to state myself what analytical methods are used for that determination. We have an oil chemist who looks after all of those details and I cannot myself state just exactly what he does. However, in a general way, he uses a distillate fraction method of determining certain oils and also the centrifuge and other apparatus for determining other oils in the mixture.

X-Q. 147. What was the general plan and object of determining all of the oil, dissolved and undissolved in the wet analysis that attached to the products?

A. Well, we determine all of the oil that is in the product. The sample of the material goes to the oil chemist in a wet state and he receives it in a wet state and determines all of the oil that is present, and makes his determination relative to the amount of dry material.

X-Q. 148. Where did you purchase the kerosene which was used in the plant on April 29th?

A. I would have to look that up to be exact about it, but we purchased most of our kerosene from the Continental and Salt Lake, Utah.

X-Q. 149. When you receive this kerosene, do you give it any treatment or do you add anything to it before you mix it with the other oils?

A. We do not attempt to add anything to it or

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give it any treatment before we mix it with the other oils. Sometimes we have no tanks available and we have to use a tank that has contained other oils, but then that is very seldom. It is quite a hard problem to take care of all these different oils that come in and it is necessary sometimes to put the kerosene as well as other oils into tanks that have contained different oils.

X-Q. 150. But nothing is mixed with that kerosene or added to that kerosene except the other oils with which it is used, is that right?

A. Nothing that I know of is mixed, and I think I would know of it if there was.

X-Q. 151. Now, was the kerosene that Mr. Phillips used in his experiments the same as the kerosene which was used at the plant?

A. Practically so, yes.

X-Q. 152. What difference is there?

A. I don't know of any difference. Might be a little difference in the small sample he used as compared to the large sample up there.

X-Q. 153. Was there anything put into it?

A. There was not, to my knowledge.

X-Q. 154. Where did the laboratory sample used by Mr. Phillips come from?

A. It came from the stock bottle in the stock supply at the plant.

X-Q. 155. And so far as you know, the oil that Mr. Phillips used, the kerosene, was the same kerosene that was used in the plant?

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A. Well, I may make that statement this way: that so far as I know the kerosene that Mr. Phillips used was practically the same kerosene that I used in my tests here in which I used kerosene, in court, and as to being the same as we use at the plant, it is supposed to be the same but there may be a little change due to age or something like that. It may be a little older sample, but as to anything being put into it or it being contaminated in any way with other oils, that, so far as I know, it is not so.

X-Q. 156. And the oil that you used here was oil obtained from the supply at the plant?

A. Yes.

X-Q. 157. Now, do you remember anything else that I asked you to bring and have not asked you about?

A. Yes, you asked for some detailed information as to the month of February.

X-Q. 158. Will you supply that now?

A. I will be glad to. I think you will find everything on this report that is necessary.

X-Q. 159. This is a full statement of the different days' proceedings in the month of February, 1917, is that right?

A. That is correct, as far as the flotation plant is concerned.

X-Q. 160. And was this prepared by you from the original records?

A. Yes.

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X-Q. 161. And these remarks, were they taken from the record?

A. Yes, they were taken from the record. That was for my own information. I found them there and copied them.

MR. SCOTT: We offer the report produced by the witness in evidence, entitled "Butte & Superior Mining Company, Flotation Plant Operations for Month of February, 1917," this being a statement of the operation for each individual day.

Table admitted marked DEFENDANT'S EXHIBIT No. 223.

X-Q. 162. Is there anything else that I asked you for that you have not supplied?

A. Not that I remember. You asked for the flow sheet, and for a report from February 4th to 28th, but that is included in this report for February. I would like to say, though, that in giving you the amount of oil used per ton in September, 1913, and other days along in that period which I have taken from this daily general mill record, that is the amount of oil used per ton of ore milled, and not per ton of flotation feed. It is based on the actual tons of ore milled.

X-Q. 163. But the difference in the figures would not be very great, would it, between the total ore milled and the new feed to the flotation plant?

A. It would not be very great, no, so it would not make a great deal of difference in the amount of oil to the flotation plant. I just wished to correct that

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statement, though, in case it was misunderstood.

X-Q. 164. Well, what would the average difference be in points?

A. I can give you a rough average of that; it would possibly make between five and seven per cent. difference, or a little greater; that is, the amount itself, if it was $1\frac{1}{2}\%$, for instance, it would be 5% off the $1\frac{1}{2}\%$.

X-Q. 165. Now, in this table that you have produced, exhibit 223, you have not included the total of the concentrates, and you have not included the total of the new feed?

A. Yes, that is included in the table that I have presented, another table before this, which gives the total of flotation feed, the tonnage of flotation concentrates for each one of those days for the month of February.

X-Q. 166. I notice that in this exhibit 223 there is a repeated statement of considerable trouble with the elevator. What was the cause of that trouble and what was it?

A. Well, it might have been due to many things. The trouble with the elevator possibly was due to the splicing coming loose, or it may have been due to some mechanical condition of the boot pulley or the head pulley; it might have been due to overloading with feed.

X-Q. 167. I see your last remark is "overloading feed to elevators, unable to handle return feed."

A. Well, it might have been due to that, if the

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elevator—They might have become overloaded, and conditions of flotation were very poor during that time.

X-Q. 168. And the correction of that would be to cut down the return feed?

A. Well, it would be to cut down the original feed, and therefore that would cut down the middling or return feed.

X-Q. 169. Well, you showed in your flow sheet yesterday a method of cutting down the middling return by putting a certain number of boxes out of operation, did you not?

A. That is one way of cutting it down all the time, but if it is running too high with those boxes cut out, then there would have to be some other method of reducing the overloaded condition.

X-Q. 170. Did you, during February, cut out some of the boxes in order to diminish the return feed?

A. No, I don't think so.

X-Q. 171. When did you commence to do that?

A. I think that was in March.

MR. WILLIAMS: Nothing further at present.

REDIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 172. Will you describe the model machine which you have had made, just generally, and you can go more into detail with these drawings, but just a general statement of what it is.

MR. SCOTT: I simply propose a general descrip-

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tion from the witness with reference to the flow sheet, because it is so difficult to get it on the record when we are looking at the machine itself. When we get this general description in, then he can amplify it.

A. The model machine which I have had made is a flotation unit in itself, and consists of a rougher having seven cells and three additional agitators, which produce a rougher concentrate and a middling product, the same as is produced in actual flotation operations. This model unit also consists of a cleaner and a recleaner. The middling product from the rougher—the rejected product from the cleaner and recleaner are returned to the head^{end} of the rougher cells by means of an elevator. This unit also consists of a feed tank, or what we commonly call a sludge tank, which supplies the feed to the first cell and also takes care of the return middlings, such as the middlings from the rougher and the tailing from the cleaner and recleaner. This machine shows in itself the working of a unit in flotation, therein all of the products are taken care of; the middlings are returned as is done in actual practice; the tailings are rejected and concentrates are produced on the cleaner cells.

R-Q. 173. I hand you this flow sheet which you have prepared and ask you to explain to the court the flow of the material, and you may at the same time, if you desire, refer to this sketch which you have had made.

MR. SCOTT: I offer the flow sheet.

The flow sheet marked DEFENDANT'S EXHIBIT No. 224.

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MR. SCOTT: I offer the perspective sketch of the machine.

Perspective sketch marked DEFENDANT'S EXHIBIT No. 225.

MR. WILLIAMS: We reserve our objection to these.

A. Referring to the flow sheet of the model flotation plant, Exhibit 224, I will now endeavor to show the flow of the material through this complete unit. To begin with, the ore and water are placed in the sludge tank, which is the feed tank for the original feed, and that tank discharges into the pulp elevator, which is this elevator here on 225, where it is elevated to the first agitating cell, which is Cell No. 1. The material then passes through these three cells in series and into the fourth cell, which has in direct connection a spitzkasten. Now, we have seven cells with spitzkasten, which we will call the rougher cells, these three previous agitating cells are emulsifiers; these seven cells are rougher cells, producing rougher concentrate and middlings. The first three cells produce a rougher concentrate, which is retreated in a cleaner cell down below, which is this cell on the perspective view.

R-Q. 174. State how the pulp goes from one cell to the other.

A. It flows from one cell to another by gravity; there being a difference in elevation between the first and second and second and third and so forth on down through and including the seven, so that the upper one

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is higher than No. 2, and therefore the flow of the pulp is by gravity into the succeeding cells.

R-Q. 175. Where is the passage?

A. The passage is in the corner of the spitzkasten.

R-Q. 176. And runs to where?

A. Directly into the agitating cell of the succeeding cell.

R-Q. 177. Does this illustrate the movement of the pulp here?

A. It does; the movement of the pulp is from your first agitating cell, which is in direct connection with the spitzkasten, into that spitzkasten; from that spitzkasten into No. 2 agitating cell, and from that cell into the same spitzkasten, which is directly connected with it; and from No. 2 spitzkasten into No. 3 agitating cell, and so forth on down the line, until the final tailing is made by No. 7 spitzkasten. That would be from this agitating cell to this spitzkasten, and from this spitzkasten into this second agitating cell, and into the second spitzkasten, and so forth on down the line.

Now, the concentrate that is produced in number one cleaner is retreated again and purified in the No. 2 cleaner, which produces a finished concentrate. The rejection or tailings from each of these cleaners, and from both of them, joins with the middlings that is produced by the last four rougher cells and goes back again into the elevator where it is elevated with the original feed to the first agitating cell. So, in this unit we have after starting and in constant operation, we have this

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battery of seven rougher cells treating the original ore plus the return middlings as shown, which is done in actual practice. The middlings are retreated in actual practice with the original ore.

THE COURT: Tailings only from the seventh?

A. Tailings only made from the seventh cell and the tailings from the cleaner and recleaner are returned again. They contain more mineral than the middlings that are produced by the last four cells of the rougher—that would be these last four cells as you look at the machine, facing you.

MR. SCOTT: Now, if the court will consent to go to the Grand Jury room we will be prepared to operate the machine, and in connection with the operation the stenographers inform me that it is almost impossible during the operation of the machine to make any record, so I would suggest that such explanation be made there as necessary to enable the court to understand the machine and then afterwards Mr. Dosenbach can take the stand when we return to the court room and put it in the record. I make this statement because the stenographers seem to despair of getting down all that is said while the machine is being operated and numerous questions are being asked. If that is agreeable to the other side I suggest we proceed that way.

MR. WILLIAMS: If it is agreeable to the court.

THE COURT: Yes.

MR. WILLIAMS: In view of the fact that you have a large machine that has a great many parts and at which things occur, I would like to send up a sufficient

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number of representatives to be able to watch the operation. One man cannot watch that machine.

THE COURT: There is no objection.

THE WITNESS: You mistook my statement, because if I was to proceed ahead of you to get ready in the two minutes it would take to get up there, you might send one man along to see that I get up there safely.

2 p. m., May 5th, 1917.

R-Q. 178. Mr. Dosenbach, will you describe your procedure in operating the model plant which you operated this morning?

A. The operation of the model flotation plant in which the experiment was performed this morning was as follows: 146 pounds of water at a temperature of 16° C. was added to the sludge tank. The agitators and elevator and mechanism in the sludge tank was added to the water in the sludge tank. This formed a pulp of 146 pounds of water and 60 pounds of ore. Next, 65 c.c. of sulphuric acid was added, together with 78 c.c. of copper sulphate solution to this pulp in the sludge tank. The pulp was then circulated through the elevator and through the rougher cells until thorough mixture was obtained, and the oil was then added to the first agitating ore emulsifying cell. The total amount of oil added was 665 c.c. This oil is equal to 574.6 grams, or the total amount of oil used in the test was 1.26 lbs., which is equal to 2.11%, or 42 lbs. of oil per ton of ore. The copper sulphate solution used was the regular copper sulphate solution that is used at the

P. 3900, L. 19, insert "then started and 60 pounds of
Butte & Superior ore were" before "added"

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Butte & Superior flotation plant, and was equal to 7.4054 lbs. per ton, or 0.1 pounds metallic copper per ton of ore. The sulphuric acid used was commercial sulphuric acid, 59° Be., and the quantity used as stated before, was 65 c.c., which was equal to approximately 8 lbs. of sulphuric acid per ton of ore. The oil was added to the pulp as it flowed through the cells; however, there was no tailing made during the time that the oil was run through the machine, in order that all of the oil should be thoroughly mixed up with all the feed as much as possible, so that when the feed became steady, it would have practically the same amount of oil in it as it continued to enter the machine. The gates were so regulated so that during the time the oil was being fed through the machine there was no concentrate or tailing made, consequently all of the pulp was circulated through the elevator and returned back through the machine again and to the sludge tank. After the oil had been entirely fed to the ore pulp, the machine was then regulated so that an overflow occurred on the first three spitzkasten and on the last four spitzkasten, and the tailing gate was opened and the tailings were then made and discharged regularly from the seventh cell of the rougher machines. A very copious mineral froth occurred on practically all of the cells at first. Later on the froth on the first three cells was much heavier than than the ^{fo}th on the last four cells, and on the seventh cell there was very little froth, as the mineral was being taken off on the first three cells.

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There was a gradual gradation of the amount of mineral contained in the froth from the first spitzkasten on down through the seventh spitzkasten, showing that in these later cells of the rougher series there was less mineral, consequently there was less froth. Samples were taken of the tailings and the concentrate, there being four special samples on the tailing and concentrate taken which represents fairly well the average of the machine. But the main purpose in demonstrating and showing the operation of this machine was to illustrate the flow of material through an operating unit which is very similar to that used at the Butte & Superior, in the matter of flow, and also to show the froth and character of froths that was formed in using oil equal to 42 pounds of oil to the ton. The operation of the cleaner and recleaner was somewhat erratic and consequently the froth and material in the cleaner and recleaner was not consistent and did not overflow continuously on account of the discharge gates and openings from these cells soaking up, causing the cells to drain very rapidly and also to fill up very quickly. The feed to the rougher cells was also somewhat erratic at times on account of the belt on the elevator slipping and giving quite a lot of trouble during the run.

R-Q. 179. What was the oil mixture that you used this morning?

A. The oil mixture used was 70% fuel oil, 18% pine oil and 12% kerosene and was the same oil mixture that is—that was used at the Butte & Superior plant on April 29th.

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R-Q. 180. That was the Sunday when the representatives of the plaintiff visited the mill?

A. On the Sunday when the representatives of the plaintiff visited the mill.

R-Q. 181. And what was the rate of flow of the pulp through the machine? I suppose you have stated in that terms of the solids, have you not?

A. Well, the rate of flow would average about a ton of ore every 24 hours—possibly more. That is just a guess on my part. I have made no tests to determine the capacity of the machine.

R-Q. 182. Well, what would you say that would amount to in a minute? Something over a pound a minute, wouldn't it be?

A. Yes.

R-Q. 183. And you had in it 60 pounds this morning?

A. Sixty pounds.

R-Q. 184. On that estimate it would take something like in the neighborhood of how long for the complete material to circulate through it once?

A. Well, it would be a pound a minute practically and therefore in an hour there would be sixty pounds circulate through it, but the sixty pounds was increased somewhat by the circulating load of middlings, which increased the total amount going through the machine.

R-Q. 185. This copper sulphate solution that was used, was that the same as was being used on Sunday, April 29th?

A. It was.

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R-Q. 186. And how does the proportion you used this morning compare with that which you used on April 29th?

A. Well, the proportions that I used this morning was in the same proportion ^{of ore} as in all of the tests that have been run in the court's demonstration and it would be a fair average of what our operations consist of.

R-Q. 187. At the mill?

A. At the mill, that would be one-tenth of a pound of metallic copper per pound of ore.

MR. SCOTT: You may cross-examine.

RE-CROSS EXAMINATION.

BY MR. WILLIAMS:

RX-Q. 188. How about the speed determinations that you made?

A. I took the speed of the agitator shaft to be 1988 revolutions per minute or 1561 peripheral feet per minute.

RX-Q. 189. You had successive agitators rotating in different directions, didn't you?

A. Yes.

RX-Q. 190. What was the effect of the inclination of the blades? Was it in every instance to tend to force the liquid upward, having in mind the direction of rotation.

A. No, it was not. The machine at first was built to work with a rope drive running around each one of the agitator shafts as shown in the perspective

P. 3905, L. 22, cancel "in which to incline or present the pulp" and insert "incline as presented to the pulp"



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drawing, and that did not give us good satisfaction, so it was changed to individual drives for each one of the agitator shafts. Consequently, working with a rope drive such as is shown in that descriptive drawing, one shaft will revolve in one direction and the other shaft will revolve in the other direction, the one following the first one.

RX-Q. 191. Well, now, did you maintain the same direction of rotation that is shown in your drawing here, that is successive agitators revolving in opposite directions?

A. Well, I haven't given that any attention at all, I don't know whether it is myself. In fact I never paid any attention to it. These belts were all taken off and put on again several times. Of course they would have to be maintained because otherwise you would have your agitator blades revolving in the wrong direction.

RX-Q. 192. Well, what is the right direction for these agitator blades, as to the manner in which they ~~in which to incline or present the pulp?~~

A. With the face up.

RX-Q. 193. That is tending to force the liquid up?

A. Yes.

RX-Q. 194. And as the machine was originally designed and operated, as shown in your drawing, exhibit 225, were the successive agitators with reverse arrangements so that they would all tend to throw the liquid up?

A. All the agitators tended to throw the liquid up.

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RX-Q. 195. How long a time was consumed in the operation which you carried on this morning?

A. About an hour and ten minutes.

RX-Q. 196. And during that operation how many times was the pulp circulated through the machine?

A. Well, I couldn't say as to that. It would be something like—it would be in actual practice, and I can't say what that would be because some of the pulp in the flotation or in any milling operation, goes through an innumerable number of times, while others go through only for a short time. So I have no way of judging as to how long any part of it was in circulation.

RX-Q. 197. But in fact as you operated the machine at first, sending the rougher concentrates back and through the machine, these rougher concentrates must have gone through several times, must they not?

A. Oh, no doubt they did go through several times.

RX-Q. 198. That is to say they were taken off and sent back immediately as being less in bulk, then released ahead of the tailings that were sent back? Is that an expression of the situation?

A. No, the middling was not sent back. In fact there was no overflow on the first three cells while the entire feed was in circulation. It was only overflowed from—it was only the overflow from the last four cells which was returned and sent back through for circulation. There was no tailing made at that time, consequently all of the feed that came into the cells was sent back again.

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RX-Q. 199. And you maintained that condition of returning everything throughout the time that you were feeding the oil to the machine?

A. I did.

RX-Q. 200. And some time beyond that?

A. Until we could get conditions regulated, yes, sir.

RX-Q. 201. Were these conditions in that machine at any time regular conditions?

A. Yes, they were, for a short time. We had considerable trouble this morning, I will admit that, but that is a condition which might exist at any time; in fact it was very similar to the questions you asked me this morning what might happen to the elevator. It showed what might happen in an actual plant, what happened up there.

RX-Q. 202. These elevators were not overloaded, were they—or this elevator was not overloaded?

A. It might have been, and I might have started it.

RX-Q. 203. Do you maintain any definite time when that machine upstairs was operating in a normal manner?

A. Why, I think it was operating in a normal manner for a great part of the time, with the exception of the cleaner and recleaner. The rougher certainly was operating normally. The cleaner and recleaner choked up considerably, and it was necessary to clean them out, but the rougher cells operated normally for quite a period, and that was the main part of the run, I thought, was to illustrate the gradual gradations of the mineral froth on the various cells.

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RX-Q. 204. Now, after you had got the oil in and were satisfied that you had reached proper conditions in the rougher cells, did you feed all of the overflow from the rougher cells down to the cleaner and recleaner, and did you continue that through the operation?

A. Yes.

RX-Q. 205. And the irregularity was in the cleaner and recleaner; they got choked up; that was why the feed was so irregular?

A. That was why the feed was so irregular.

RX-Q. 206. Of course the consequence of that was that the concentrate of the last machine, the recleaner, would accumulate for quite a time, and then come out in bunches; that was, I suppose, a description of what happened?

A. That condition existed at one time there that I know of, when I looked down that way and saw it; on account of the discharge gate or opening leading from the recleaner cells choking up.

RX-Q. 207. Of course in the regular operations the tailings go to waste, do they not?

A. They do.

RX-Q. 208. And you got to the condition nearest approaching regular operations when you were sending your tailings out into the tailings receptacle?

A. Yes.

RX-Q. 209. I noticed in the table that you put in this morning, defendant's exhibit No. 223, that I asked you for the percentage of oil in the tailings, which is

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the next to the last item; that for the 27th of February is wholly different from any other item; can you explain that?

A. Which one is that?

RX-Q. 210. You have, for instance, on the 28th 0.45; on the 27th 0.062; on the 28th 0.68. Now, that 0.062 seems to be very erratic. What do you think of that?

A. It is an error; it should be 0.62.

RX-Q. 211. I have made the correction in the original exhibit. Now, isn't it a fact that ^{that} column showing the amount of oil in the tailings shows that you are running to waste in the tailings more than twice as much oil as you used ~~to~~ before December 22nd?

A. It does; sure.

RE-DIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 212. Mr. Dosenbach, are there any more things which Mr. Williams inquired about that you have?

A. No, I think that is all, with the exception of some assays that are not completed, and the returns are not out.

MR. SCOTT: I offer in evidence the machine which Mr. Dosenbach operated this morning.

Machine admitted without objection marked
DEFENDANT'S EXHIBIT No. 226.

J. T. Shimmin.

MR. SCOTT: I offer in evidence the flow sheet marked 224, and the drawing, exhibit No. 225.

EXHIBITS 224 and 225 ADMITTED WITHOUT OBJECTION.

MR. WILLIAMS: I should say, in regard to the machine, on behalf of the plaintiff, that as an illustrative model of something in which the flotation process may be carried out, there is no objection to it. As a representation of what is practically our standard machine there is no objection to it. But if the defendant is relying upon it as a representation of anything in the prior art, then we object to it as wholly irrelevant. With those qualifications it may be admitted.

THE COURT: Well, of course, it is like the other exhibits; it is in for all purposes that it ought to serve. and they may be pointed out in argument.

J. T. SHIMMIN recalled on behalf of defendant for further

DIRECT EXAMINATION
BY MR. SCOTT:

Q. 1. You are Mr. J. T. Shimmin who testified before?

A. Yes.

Q. 2. You have a report, I believe, of the operations of the Butte & Superior flotation plant on Sunday, April 29th, from 1 to 5 p. m., during the interval

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when the representatives of the Minerals Separation Company were present?

A. Yes.

Q. 3. And this is the report?

A. That is the report, yes, sir.

Q. 4. Were these operations conducted under your charge?

A. Yes.

Q. 5. And those reports are the regular reports prepared in the ordinary course of the administration of the plant?

A. Well, they are more complete, but we keep practically the same record of all our operations.

Q. 6. To the best of your knowledge and belief this is a correct report of the operations referred to?

A. Yes, sir.

MR. SCOTT: I offer the report referred to by the witness in evidence.

Report admitted and marked DEFENDANT'S EXHIBIT 227.

MR. WILLIAMS: As far as I can see, your honor, this repeats the testimony of the witness as to things that occurred, but I have no objection to it provided we upon examination find that it is all right. It is a long document. It may facilitate matters to have it in the record.

J. T. Shimmin.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q 7. Mr. Shimmin, is this a report for the whole day?

A. No, it is just the period from 1 to 5 p. m. of the 29th.

X-Q. 8. Where is your report of the whole day, the regular official report?

A. Well, that is not finished; I have got it in the rough, is all. I can furnish you with a copy of that, though.

X-Q. 9. I want to see the whole day's operations. As a matter of fact our representatives were there at half past ten, and from there on, although it is true the samples were not taken except during that period.

A. This covers the period that the samples were taken.

X-Q. 10. I want the record for the whole day's run, and the day before and the day after, and I would like you to bring me the original data that are on record in your office.

A. All right.

X-Q. 11. Now, these notes that have been put upon this—this first document here is a letter by you, and is your report to Mr. Bruce, the manager of that operation?

A. Yes, sir.

X-Q. 12. And to that you append these sheets?

A. And there is a letter from the chief chemist and the oil chemist.

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X-Q. 13. The chief chemist being R. B. Stringfield?

A. No; he is the oil chemist.

X-Q. 14. Who is the chief chemist?

A. Edward Walser.

X-Q. 15. And then there is this last letter to you; who is that signed by?

A. That is the head sampler?

X-Q. 16. And his name is—?

A. T. R. Featherly.

MR. WILLIAMS: It would seem that the regular procedure would be to call these men, but I am quite willing to take it prima facie in this form, and see if we can be satisfied with it.

THE COURT: Very well; they are available no doubt.

THE WITNESS: I have some figures that you asked for the other day, Mr. Williams, in regard to the assay of the sulphate.

X-Q. 17. The assay of the sulphate of copper that you purchased from the Anaconda Company?

A. No, just the amount of copper sulphate and sulphuric acid which we were using during the month of November, 1916. You also asked for the period of time that we used the reconstructed oil.

MR. SCOTT: I offer the memorandum produced by the witness entitled "Butte & Superior Mining Company, Data Compiled from Original Record, Flotation Plant Operations, Month of November, 1916."

Table admitted marked DEFENDANT'S EXHIBIT No. 228.

J. T. Shimmin.

X-Q. 18. Now, that other matter?

A. On November 17th reconstructed Barrett oil was used for 16 hours, and No. 2 pine oil for eight hours.

X-Q. 19. And each used alone?

A. Each used alone, yes.

X-Q. 20. In what proportion?

A. They were used separately. The reconstructed Barrett oil was used exclusively for a 16-hour period and the pine oil exclusively for eight hours.

X-Q. 21. In what proportion per ton of ore?

A. Well, those sheets that I gave you show that; I don't remember off-hand. On November 18th the reconstructed Barrett oil was used for 18 hours and No. 2 pine oil for 16 hours.

X-Q. 22. Have you described what reconstructed Barrett oil is, how it is made?

A. No, I have not. I don't know what this particular reconstructed Barrett oil was, but ordinarily we use about 95%.

X-Q. 23. How is it made; what does reconstructed mean?

A. Well, it is just simply distilled or cooked for a period of three or four hours with sulphur.

X-Q. 24. It is distilled under conditions so that the condensed part flows back?

A. Flows back, yes.

X-Q. 25. In a reflex condenser?

A. Yes.

X-Q. 26. That No. 2 pine oil, how is that differentiated from No. 1 pine oil?

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A. It is simply a marking that they have.

X-Q. 27. A commercial name?

A. A commercial name, yes.

X-Q. 28. Yaryan, is it?

A. Yes, I think it is; in fact I am sure it is.

WITNESS EXCUSED.

MR. SCOTT: I understand that samples have been furnished to plaintiff's representatives of all of the oils mentioned in these various reports, and that being the case I would like to have the record so show.

MR. WILLIAMS: Well, I don't know whether it is so or not. I can get reports.

MR. SCOTT: Very well, I will have Mr. Dosenbach testify to it.

MR. WILLIAMS: I think we got some nine samples yesterday, but I am not ready to say we have samples of everything. I will when I know it.

BEN H. DOSENBACH, recalled, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 213. Will you please state what oil samples you furnished to a representative of the plaintiff and to what representative you furnished them?

A. I furnished a sample of number 1 creosote, number 2 creosote, Yaryan pine oil, Barrett's number 4, Graybull fuel oil, Jones' crude oil, Graybull paraffin

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base oil kerosene and Yaryan mixed pine to representatives of the Minerals Separation Company, Mr. Higgins and Mr. Truran. These samples were requested of me to furnish.

Q. 214. They were samples of the actual materials used in the mill?

A. They were such as we use in the Butte & Superior Company's mill.

Q. 215. Were there any other samples of anything else furnished to them?

A. Yes, there have been samples furnished of every test that was made.

Q. 216. In court you mean?

A. In court.

Q. 217. Yes, but I mean the mill materials.

A. And samples were furnished Sunday of everything that was used, oils and acids and sulphates.

Q. 218. Sunday the 29th of April?

A. Yes, sir.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 219. Mr. Dosenbach, it appears that these pine oils are used separately, and you have given us a mixed sample?

A. I gave you two samples. The oil is contained in one tank, which contains several pine oils and when we use from that tank up there consequently we can not use either one of them separately. We do not have the capacity to put one particular oil by itself so that one

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tank contains mixed pines; and a sample of this was furnished and also a sample of the standard pine was furnished.

X-Q. 220. And that standard pine, has it any particular name? Is it number 1?

A. No, we call it "standard pine oil" because it has the greater specific gravity, and is somewhat purer than the other.

X-Q. 221. Can you furnish a specimen of the number 2 separate, that you formerly mixed with the standard?

A. I think it may be possible from the stock bottles to furnish that.

X-Q. 222. Will you do so?

A. I will, yes, be glad to.

MR. KREMER: Mr. Williams, Mr. Chapman and Mr. Truran, whose names are mentioned, are your representatives, are they not?

MR. WILLIAMS: Oh, yes, yes.

WITNESS EXCUSED.

MR. SHERIDAN: If the court pleases, I have an understanding with counsel on the other side that we may introduce a printed transcript from the stenographer's record taken from the argument of both sides in the Supreme Court. We desire to enter a part of the argument which appears on page 85, Mr. Kenyon's admission. In reference to that he wants me to read into the record beginning on page 83 down to the bottom of page 85 and that I agreed to do. They will object to its competency.

MR. GARRISON: No, we do not object to its competency. We object to its relevancy and materiality. We do not require them to produce any proof that the language contained on the pages of this book which are referred to is the language used by Mr. Kenyon or the language used by Justice McReynolds or by Justice Pitney, or whoever uttered the language. We will waive the competency of proof. We do say it is utterly irrelevant and immaterial.

MR. SHERIDAN: We will read that so it will appear in the record and then offer the book as defendant's exhibit 228.

MR. GARRISON: By what procedure do they read it into the record before your honor has admitted it?

THE COURT: What are you offering?

MR. SHERIDAN: We offer the part on page 83, page 84, and page 85. The reason of the materiality of it is this: First, it goes to show the definition these gentlemen have placed on their invention; and, secondly, they are alleging in this case that we are estopped by the Hyde former adjudication. Certainly anything that makes then in favor of Hyde in the former adjudication would make in favor of the defendant here; and any admissions made in solemn court such as they are, are undoubtedly of advantage to the court in any case in which he is a party. We have set it up as a defense, estoppel.

THE COURT: Well, there ought to be some law about that. I will allow it to go into the record, however.

MR. GARRISON: Your honor does not care to hear me before the ruling?

THE COURT: Nò, it will be before—let's see, how many other courts? One court at least. The objection will be overruled and the matter will be admitted, the three pages, and if entitled to no consideration the court will give it none in making up its decision.

Pages in question admitted in evidence and marked DEFENDANT'S EXHIBIT 229.

MR. SHERIDAN: (Reading): "Washington, D. C., Tuesday, October 1, 1916.

"Argument of Mr. William Houston Kenyon in reply for Petitioners-Complainants.

"MR. KENYON: May it please the court, the question at issue, and the only question, is the question of invention. Did the step that our patentee took constitute invention? The court below said no; it was simply a matter of degree. Respondent's counsel here defends that proposition by saying that our result is attained not by the diminution in the amount of oil, but by some trick of agitation, some novelty of agitation. I will address myself first to that latter proposition.

"And the history of the birth of this invention is a complete answer to it. (Record pp. 446-448-451).

"If your honors have not already marked those pages in the record, I will ask you to mark them; the whole of page 448, the whole of page 451, and, on page 445, the paragraph just below the middle, commencing 'peripheral velocity of cone.'

“Contemporaneous documentary records, written within a few weeks of the birth of this invention—evidence of an extraordinary character of the birth of a most extraordinary invention. These inventors were working on the Cattermole process—which, as has been explained, agglutinates by oil in about three per cent proportion the metal particles into bigger granules such that they sink against an upcurrent of water which carries the gangue up and away—the Cattermole process. They were experimenting with modifications of all the conditions of that process. Among them one line of investigation was as to the influence of changes of peripheral velocity. All sorts of variations, from 840 to 1,460, in the speed of the cone, were made, but the invention in issue was not born.

“Another line of investigation was as to the influence of changes in the amount of oil (page 447, the seventh item). Out of that series of experiments (where the only change made from experiment to experiment was in the amount of oil—a gradual diminution in the amount of oil, all other things remaining the same) was born this invention.

“And the record of it is right there on page 448. ‘Details of Experiments,’ the last column, ‘Remarks,’ ‘Float vastly increased’—tracing that back you see it was with three-tenths of one per cent of oil; and just below ‘Float’ again ‘vastly increased’—tracing that back it was with one-tenth of one per cent of oil.

“This float phenomenon appeared (page 451) when the oil had been reduced to about one-half of one per

cent, said the inventors, after studying the process six weeks.

"As the amount of oil was reduced granulation practically ceased at a range of about one-half of one per cent of oil, but a certain amount of black mineral froth was noticed. They were trying to send the values down, but they began to come up to the top.

"MR. JUSTICE DAY: Is that on page 451?

"MR. KENYON: Page 451, the third paragraph:

" 'A certain amount of black mineral froth was, however, noticed as a result. On successively decreasing the amount of oleic acid below 0.5 per cent (that is one-half of one per cent) it was found that whereas granulation ceased there was a growth in the amount of mineral float-froth under these conditions, and that the production of such float-froth appeared to reach a maximum when about 0.1% of oleic acid on mineral was used.'

"If that evidence is true it disposes of the contention that this phenomenon which has revolutionized ore concentration the world over is to be explained as some trick of agitation.

"MR. JUSTICE DAY: How do we know that fact, that it has revolutionized ore concentration the world over?

"MR. KENYON: How do we know it? This record shows that up to 1912 about \$9,000,000 worth of values had been taken out, in Australia and Sweden and Chile, from dump heaps that had been valueless theretofore, by this process. The testimony that was taken in 1915 before Judge Bradford shows what had

happened in the intervening three years, as pointed out in his opinion, during which three years an astounding development occurred in this country.

"MR. JUSTICE M'REYNOLDS: I would like to ask you when in this process of reducing oil your invention came into existence.

"MR. KENYON: At about one-half of one per cent of oil.

"MR. JUSTICE McREYNOLDS: Before you got to one-half of one per cent did you have any invention?

"MR. KENYON: We were passing from the region of Cattermole, which was a distinct—

"MR. JUSTICE McREYNOLDS: I want to know when your invention came into existence.

"MR. KENYON: This invention was not reached, I should say, from those figures, until about 0.5, that is, one-half of one per cent., of oil was reached.

"MR. JUSTICE McREYNOLDS: At one per cent you had no invention?

"MR. KENYON: No.

"MR. JUSTICE McREYNOLDS: At one-half of one per cent you did have invention?

"MR. KENYON: It began to come. Remote, but it began to come. At 0.3 of one per cent the float vastly increased. At 0.1 of one per cent ~~of oil~~ the float again vastly increased.

"MR. JUSTICE McREYNOLDS: When this float has more than one-half of one per cent of oil it does not infringe?

"MR. KENYON: It does not infringe.

Frank R. Wicks.

FRANK R. WICKS, recalled, testified as follows:

DIRECT EXAMINATION.

BY MR. KREMER:

Q. 1. I believe you have some tabulations and some information Mr. Williams requested?

A. Yes, sir.

MR. KREMER: Mr. Williams, these are matters that I think you have requested Mr. Wicks to produce, and he now produces them. So as to keep the numbers correctly we will offer them, a document "Chino Copper Company, Hurley plant, flotation data for period from November 1 to 30th, inclusive, 1916, re-treatment of concentrates."

THE WITNESS: That is a copy of the original report.

Report admitted in evidence and marked DEFENDANT'S EXHIBIT 230.

MR. KREMER: We now offer the following paper, headed Chino Copper Company, Hurley plant, resin and reagents used in vanner concentrate plant, during November, 1916.

Report admitted in evidence and marked DEFENDANT'S EXHIBIT 231.

Q. 2. Mr. Wicks, I believe you stated that you came to Butte in the latter part of 1912?

Frank R. Wicks.

A. Came to Butte first the last week in October, remaining here for about two weeks and then I came back on the first of Deecmber to take charge of the plant.

Q 3. Who was in charge of the Butte & Superior plant as superintendent at that time?

A. That is the time that I came here in 1912?

Q. 4. Yes.

A. Well, Mr. Atwater was general superintendent, having charge of both the mine and the mill; and Mr. Collins was superintendent of the mill before I took charge.

Q. 5. What if any, conversation did you have with Mr. Atwater at that time with reference to the employes of the company engaged in and about the operations?

MR. GARRISON: I object. Conversations between employes of the defendant company certainly can't bind the plaintiff in this case.

MR. KREMER: This is for the purpose of impeaching the testimony of Mr. Atwater, who stated that Mr. Hyde was an employe. Mr. Atwater stated in his testimony that Mr. Hyde drew a salary from the Butte & Superior Company and that he had the right to discharge him. This is for the purpose of impeachment of the testimony of Mr. Atwater, to show a contrary statement by (him to) the witness.

THE COURT: Well, did you ask him, Mr. Atwater?

MR. KREMER: Yes, I asked him what if any conversation he had had with Mr. Atwater.

Frank R. Wicks.

MR. GARRISON: He means did you ask Mr. Atwater for the purpose of laying a basis for the contradiction.

MR. KREMER: I don't think we have to lay a basis for impeachment of that kind when the witness' statement is absolutely contrary to the statement he has made in the course of his employment.

THE COURT: I think so. I know of no exception. If you are going to impeach him by showing contrary statements by him, certainly the foundation must be laid. You can show the fact to be otherwise, that Mr. Atwater had no such authority.

MR. KREMER: I can show that in another way. When Mr. Atwater was off the stand and they closed their case before this information came to us.

THE COURT: I know, but that is your misfortune, but it does not do away with the law governing such testimony.

MR. KREMER: The obstacle is not *Ossa Pelion*, by any means, because I can find another way.

Q. 6. Who was in the employ of the Butte & Superior Company at the time you came there in the latter part of 1912, in the matter of conducting of flotation operations?

MR. GARRISON: I object. I can't see how it is relevant as to who was in the employ of the Butte & Superior Company' at that time.

MR. KREMER: Positive testimony that a certain man was in the employ of the company. We have a right to meet that, not by the statement of anyone, but by the fact.

Frank R. Wicks.

THE COURT: What was this witness' relation?

MR. KREMER: He was mill superintendent; came there to take charge of the mill and did operate the mill.

THE COURT: I will be frank with you and say it is so long since Mr. Atwater testified that it has passed my recollection somewhat except in its more vital portions. Certainly if Mr. Atwater testified that a certain person was in the employ of the company, and if that was material, why, certainly, the defense has a right to disprove it.

MR. KREMER: The only attempt they have made to prove their allegation that he was an employe of the company. They have alleged that he was an employe of the company. That is the only attempt they have ever made to prove that statement.

THE COURT: Well, get a little more directly at it, with this witness. Ask him whether he knows the relation.

Q. 7. MR. KREMER: Was Mr. Hyde in the employ of the Butte & Superior Company at the time you came there?

MR. GARRISON: Now, if your honor please, that must be a matter of law.

THE COURT: Ask him what he knows about the relations between Mr. Hyde and the defendant, what he knows of his own knowledge.

MR. KREMER: Very glad to ask it in any way court or counsel direct. In fact, it is only the ultimate conclusion we are desirous of reaching.

Frank R. Wicks.

Q. 8. What do you know of the relations between Mr. Hyde and the company, if there was any, in October, 1912, and the latter part of 1912, when you came to the plant?

A. All the information I have is what Mr. Atwater told me when I took the place.

Q. 9. Who was Mr. Atwater?

A. He was general superintendent of the plant.

Q. 10. What did Mr. Atwater tell you?

MR. GARRISON: Now, I object to what Mr. Atwater told him.

THE COURT: Objection sustained.

MR. KREMER: Exception. Now, if your honor pleases, I desire to make an offer to prove. I suppose I may just as well state it?

THE COURT: Certainly.

MR. KREMER: We desire to prove by the witness, F. R. Wicks, now upon the stand, that the witness M. W. Atwater, who has previously testified in this case, stated to Mr. Wicks when Mr. Wicks came to the plant that Mr. Hyde was not an employe of the Butte & Superior Copper Company, Limited. We desire to prove by the witness upon the stand and offer to prove by the witness upon the stand that the witness asked Mr. Atwater who Mr. Hyde was and that Mr. Atwater replied that Mr. Hyde was the originator of the Hyde flotation process which was then being used in a general way, that he told—that Atwater told the said witness, Wicks, that Hyde had undertaken to direct the installation of a flotation equipment, and

Frank R. Wicks.

the development of a successful plant, but that he was having plenty of trouble doing it. We desire further to show by the witness, Wicks, upon the stand, that the said witness asked the said Atwater if Hyde was retained as consulting engineer or whether he was in the employ of the company, and that the said Atwater told the said witness, Wicks, now upon the stand, that Hyde was neither an employe nor a consulting engineer, but that he had contracted to do certain things, and that up to that time hadn't succeeded in doing them. We desire to further prove by the witness upon the stand that the said Atwater explained to the said witness, Wicks, now upon the stand, the contract between Hyde and the company and showed him a copy of the contract and allowed the witness to read it over so that he would be familiar with the situation. We desire further to show by the witness upon the stand that he came to Butte to rearrange the milling forces and to assume the position of mill superintendent. We desire further to show by the witness upon the stand that he became mill superintendent and that the said Hyde was not an employe of the said company, but was operating as an independent engineering contractor.

That covers the offer, and in making the offer I desire to state that we will prove any one or all of the statements there contained.

MR. GARRISON: I do not care to be met with an offer. I prefer to have him ask the witness questions.

Frank R. Wicks.

MR. KREMER: We have a right to make an offer after the court has ruled.

THE COURT: He asked a question which was objected to and the court sustained it. Now, he simply makes an offer of what he would prove.

MR. GARRISON: I am faced now with the necessity of objecting to this offer, in which case, if your honor pleases—

THE COURT: This offer is only a continuation of the former question. It is only the same matter, just what Mr. Wicks says.

MR. KREMER: The offer is in compliance with the ruling of the court. I cannot continue to ask questions.

THE COURT: State your objection.

MR. KREMER: You may interpose your objection.

MR. GARRISON: Thank you, sir.

MR. KREMER: You are entirely welcome.

THE COURT: Proceed.

MR. GARRISON: I do not care unless your honor rules that that is the practice in this district.

THE COURT: It is the practice here.

MR. GARRISON: I am then put at the peril of admitting that he can prove all of this and objecting that it is immaterial. I do not care to be fronted with that. I would prefer infinitely to have him ask the questions. I don't think this witness can testify—

MR. KREMER: Do you withdraw your objection to the previous question.

Frank R. Wicks.

THE COURT: No. I remember a case once before a jury and counsel asked a question and it was objected to and sustained. The jury was sent out and he made a very long and very striking offer, and the court permitted him to call his witness and see if he could testify to that. He immediately withdrew his offer. Now, there is no charge in that—

MR. KREMER: If that is a challenge, I accept it.

THE COURT: That is what counsel is guarding against. He don't want to admit that all of these things would be testified to because sometimes strategy and enthusiasm will lead a counsel to offer a lot more than he can carry out. Now, he has a right to take that view, for his protection.

MR. KREMER: I am willing he may object to any part of the offer.

THE COURT: He only asks a division, so that you only ask one question at a time,—well, as a matter of fact, when you don't have a jury in court it won't matter. It will really go into the record.

MR. GARRISON: I shall have to object to some of these questions. I think I would like to have this gentleman's views on certain questions.

THE COURT: Ask questions.

Q. 11. MR. KREMER: Did you have a conversation with Mr. Atwater with reference to Mr. Hyde's connection with the Butte & Superior Copper Company, Limited, when he came to Butte to take charge of the milling operations.

Frank R. Wicks.

A. Shortly after I came there; yes, sir.

Q. 12. State the circumstances of that conversation?

MR. KREMER: Now, I want to be very fair with him and I won't ask questions that will lead him.

MR. GARRISON: I do not think that that can show the relation between Mr. Hyde and the Butte & Superior Company. We already have in evidence a written contract which counsel says was shown this gentleman, and says Mr. Atwater gave him a copy of that contract. I don't know whether that would be relevant or not. He may have put a construction of his own on that contract. I doubt very much whether that would be relevant. We have the original showing exactly what the money was paid for, in his vouchers, and we have them here and it seems to me it resolves itself into a question of law and Mr. Atwater, I have found from reading the testimony—testimony in this respect, reading from page 139 of the transcript: “Q. 13. During the time that you were superintendent, from the date that you mention in 1911 down to the time that you ceased your connection with the company in February of 1913, did you at any time pay moneys to James M. Hyde on behalf of the Butte & Superior Company, the defendant? A. Yes. Q. 14. Did you pay him a flat sum of money per day or did you pay him moneys made up of items of expenses or both? A. We paid him so much a month.” Now then, the

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vouchers show payments monthly, payments with all the descriptive language that the vouchers of these companies have upon them to show for what the payment was made and the contractual relations, about which this gentleman I do not understand has any original information. If he has, that is another matter. If he is here to testify to any phase of the making of the contract between Hyde and the Butte & Superior, I shall withdraw my objection instantly; but as I understand it he came there long after this contract had been made; and there is no offer to prove that he had anything to do with that. Then his construction of the contract must be immaterial. What characterization he would put upon these payments certainly would be immaterial.

THE COURT: Are you shifting your ground from the objection formerly made which was that this can only serve to impeach Hyde and no foundation has been laid?

MR. GARRISON: You mean Atwater?

THE COURT: Yes. Are you abandoning that?

MR. GARRISON: No, sir, I am not. I am reinforcing that ground because he is now asking what talks he had with Atwater about Hyde. I cannot see that that is material.

THE COURT: You desire counsel to put it in the form of a question?

MR. GARRISON: I do.

THE COURT: So state. If you have any objec-

Frank R. Wicks.

tion to this question state it so the court can tell and we can go on to the next one.

MR. GARRISON: My objection is that conversations between Mr. Wicks, this witness, and Mr. Atwater inquired about by counsel in this case, are irrelevant and immaterial; and, if intended to impeach Mr. Atwater, no proper foundation is laid for them.

THE COURT: The objection will be sustained.

MR. KREMER: I now renew my offer. I am perfectly willing to rest upon my offer. I made no request that I be permitted to ask any further questions. I abide by the ruling of the court and I now renew my offer to prove by this witness as previously stated.

THE COURT: Let's see your offer.

MR. KREMER: I haven't it reduced to writing, but I will show you from what I read. This is the substance of it.

THE COURT: This offer is in reference to what Mr. Atwater may have stated to this witness.

MR. KREMER: No, I want to show as I stated before, we desire to show the relationship existing. First of all, I stated it was for the purpose of impeaching the testimony of Mr. Atwater. My first question was—I desire to show by this witness first that Mr. Atwater's statement is to be discredited because of a statement of a different character made to the witness. That is one reason. Second, I desire

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to show by the witness the connection of Mr. Hyde with the company as outlined by the general superintendent of the company, Mr. M. W. Atwater, who has previously testified in this case, and to show that notwithstanding the fact that Mr. Atwater as previously upon the stand stated and at a time when we did not have this information available or know of it, has stated that he paid Mr. Hyde a salary and that he had the right to discharge him. And for that reason we consider this testimony competent and most material.

MR. GARRISON: I would like to have counsel point out that portion of Mr. Atwater's testimony that he proposes to show this statement of conflict.

MR. KREMER: I don't know the page of it.

MR. GARRISON: Then point out one place.

MR. KREMER: All right, I will. I will show you the word "salary."

MR. GARRISON: All right, do so.

Q. 15. First of all, I will supplement this; page 138. "Did you pay him any money? A. We paid him so much a month." I will show you the word salary.

MR. GARRISON: I remember the word salary, and I remember that he took it back later. He took back a lot of things.

MR. KREMER: We have a right to impeach anything that he said on direct, notwithstanding his equivocations on cross examination.

THE COURT: Under no rule by which Mr. Atwater's statement to this witness could be admitted

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here to serve the defendant except under the rule of impeaching testimony. If there is any such rule I am either ignorant or forgetful of it at this time. No foundation having been laid by the method always understood—"Did you say thus and so to so and so in the presence of such parties at such a time and place?" It is inadmissible.

MR. KREMER: Your honor realizes the situation.

THE COURT: Yes, but I have had that question up before, and it has gone to the Circuit Court of Appeals of this circuit in the case of Egan vs. Great Northern, and it was ruled out there and the court sustained me.

MR. KREMER: That is the statement of a witness (I think I can see a difference here), for the purpose of impeaching his credibility. This is testimony with reference to a statement of fact. Here is a man who was general superintendent of the company, charged with knowledge, and of knowing who were his employes. His statement is a statement of fact; and if a condition is altered, whereby a former general superintendent seeks to take the stand to testify against his former employers with reference to something that was presumably within his knowledge and based on what occurred under his superintendency, then it becomes fact testimony as to what he said with reference to the condition of affairs when he was superintendent. Your honor must bear this in mind—I appreciate that it is a nov-

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elty, but Mr. Atwater's sole information given here on the stand was of a character relating to his superintendency; and certainly, if that is testimony—A statement made by him at that time in connection with the same matter is a statement of facts, rather than a mere question of direction to his credibility. The situation is a trifle unusual, but I see no way of raising this question under the objection of the parties and the objection being sustained by the court, than by an offer of proof, which I have made in accordance with the practice. I have not attempted to impeach anything in that offer, save and except that which I propose to prove and which I have here offered, the data from which I made the offer of proof.

MR. GARRISON: Do I understand that under the practice I have got to accept or reject that offer?

MR. KREMER: No, I think not, Judge Garrison; if you will wait a moment—

MR. GARRISON: I beg your pardon; I will sit down.

MR. KREMER: I wish you would, occasionally; the statement whether he is to accept or reject is as to the competency of that testimony. If that testimony is competent, and if he has relied upon his knowledge of the rules of evidence in directing the objection to the court, and the court is in accord with his view, and he desires that objection to remain, then certainly he is charged with the truth of that

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testimony, or at least he is charged with the knowledge that the witness would testify to it.

THE COURT: The error, if error is committed—I don't understand that the Circuit Court of Appeals will take it as the same as though that testimony were in the record. If it is sufficiently material they will send the case back to give an opportunity to have it introduced. But I remember another case where the court sustained an objection—perhaps you have heard of it—The witness was asked to relate a certain occurrence in a conversation, and the witness was asked "What did Mary say?" and it was objected to and the objection sustained, and it went to the Court of Appeals, and they held that it was error and sent the case back, and when it came back they asked the witness again, "What did Mary say?" and the witness answered "Mary did not say anything." So that involved the Circuit Court of Appeals for that trifling matter. (Laughter.) Now, it is something the same here. If I exclude this and it goes to the Circuit Court of Appeals, the Circuit Court of Appeals will never say that the defendant has admitted that that is true; they will send it back to find out whether Mr. Atwater did say anything to the witness or not.

MR. KREMER: The situation is different; we have already told you what "Mary" is going to say.

THE COURT: Yes, but the witness has not testified to it. It does not involve the construction the plaintiff places on it. The court could inquire, as a

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matter of good faith, like it did inquire as it has told you about, and I think the offer is properly made, and you can state your objection to it as it is.

MR. GARRISON: I am not going to object to the offer, your honor.

THE COURT: Proceed, then.

Q. 16. What did Mr. Atwater say with reference to Mr. Hyde?

MR. GARRISON: Now, I object to the question, if your honor please.

THE COURT: I see the method counsel is taking, and I can not say that he is not correct. He simply intends now that you should put your questions as you desire, and he will object to each specific question as it comes, if he wants to. The objection will be sustained to this question.

Defendant excepted.

MR. KREMER: Now, if your honor please, I renew my offer to prove.

THE COURT: The court will not entertain the offer to prove. You can put specific questions to this witness, which will cover your offer to prove. You can have an exception to the court's ruling on that?

MR. KREMER: I don't desire an exception; I only want an understanding. I would like to save time, if possible.

THE COURT: The court will finally say how its time should be taken up, and it says it will give you the time.

Frank R. Wicks.

MR. KREMER: All right, your honor, I will proceed on that line.

Q. 17. When you came to Butte, in the latter part of 1912, what conversation, if any, did you have with Mr. M. W. Atwater with reference to the employes—with reference to who were the employes in the Black Rock mill?

MR. GARRISON: That is objected to as incompetent, irrelevant and immaterial.

Objection sustained; defendant excepted.

MR. GARRISON: If it is intended to contradict Mr. Atwater there is no basis—

MR. KREMER: The court has ruled.

THE COURT: There is time enough for one at a time. I did rule, however, before you finished your objection, however, Mr. Garrison.

MR. GARRISON: I wanted to say that if it is intended to contradict Mr. Atwater, no proper basis has been laid.

Objection sustained; defendant excepted.

Q. 18. What conversation did you have with Mr. Atwater with reference to Mr. Hyde's connection with the Butte & Superior Copper Company Limited?

MR. GARRISON: I object to that, if your honor please, if it is intended to contradict Mr. Atwater, on the ground that no proper basis has been laid; and otherwise I cannot see how it is relevant or material to any issue in this suit.

Objection sustained; defendant excepted.

Frank R. Wicks.

Q. 19. What did Mr. Atwater say to you with reference to whether Mr. Hyde was an employe of the Butte & Superior Mining Company, Limited?

MR. GARRISON: I repeat the objection that I just previously made.

Objection sustained; defendant excepted.

Q. 20. What, if anything did Mr. Atwater state to you with reference to an inquiry propounded by you, as to whether Mr. Hyde was a consulting engineer or whether he was in the employ of the company?

MR. KREMER: At this time I desire to state that if that is objected to on the ground that it is leading I will reform the question.

MR. GARRISON: I don't object to it on the ground that it is leading; I repeat the objection I made to the previous question.

Objection sustained; defendant excepted.

Q. 21. What if anything did Mr. Atwater say to you with reference to Mr. Hyde's contract with the Butte & Superior Copper Company, Limited?

A. Mr. Atwater told me that that contract constituted the only connection between Hyde and the company.

Q. 22. Did he show you a copy of the contract?

A. He did.

Q. 23. Mr. Wicks, I present to you Plaintiff's Exhibit No. 1 and ask you to glance over that and state whether or not the contract there set forth is a copy of the contract which you refer to.

Frank R. Wicks.

A. I can not identify it exactly from this copy, because I can not identify the signatures.

Q. 24. Would you just glance over it and see the substance of it, and if necessary, read it.

MR. GARRISON: This is the only written contract there was, isn't it?

MR. KREMER: There was a modification of this contract. I don't think the witness ever saw the modification.

A. I can identify it by one portion of it in a moment, when I find it.

MR. GARRISON: Outside of the record I will agree that it is the same contract so the witness may be at liberty to answer yes if he likes.

MR. KREMER: Very well, it is the same contract.

MR. GARRISON: I won't cross examine him about that.

Q. 25. It is, the contract, isn't it?

A. All right, with that understanding I can identify it.

Q. 26. When did you assume charge of the mill?

A. On the first of December, 1912.

Q. 27. Did you have control of all the men operating in that mill?

A. Yes, sir.

Q. 28. All of the employes of the company?

A. All of the employes of the company who were connected in any way with the milling operations or

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with the surface operations which pertained to the milling department.

Q. 29. Did you, Mr. Wicks, know James M. Hyde during that time?

A. Yes, I met Mr. Hyde then.

Q. 30. Was Mr. Hyde employed at that mill?

MR. GARRISON: I object to that.

THE COURT: The witness has already testified that he knew nothing of the relations of Mr. Hyde other than what Mr. Atwater told him, and this question calls for a conclusion; he can only make his answer from that information.

MR. KREMER: No, your honor, I believe the witness testified as to what Mr. Atwater testified as to the contract, and Mr. Atwater told him that that was the only connection with the company. This witness then took charge of the mill himself, and had superintendence over the mill and all the employes of the mill.

THE COURT: You can ask him what control he exercised over Mr. Hyde. This question calls for a conclusion and the objection will be sustained.

Defendant excepted.

Q. 31. What relationship—or at least what control did you, as mill superintendent, have over Mr. James M. Hyde. if any?

A. I had none whatever.

Q. 32. Was Mr. Hyde in and about the mill?

A. He visited the mill several times, yes.

Frank R. Wicks.

Q. 33. Any particular portion of the mill?

A. Particularly the flotation plant. I showed him through the other part of the plant, but he was around the flotation plant himself.

Q. 34. What would he do about the flotation plant?

A. Stand around and look at it.

Q. 35. Anything else?

A. I never saw him do anything else.

Q. 36. As mill superintendent it was your duty, I suppose to O K or approve the pay rolls of the company with reference to the compensation paid the men who worked in the mill?

A. Yes, I approved the mill payrolls, I think, every month, and during a part of the time I also approved the entire plant payroll.

Q. 37. Did the name of James M. Hyde appear on that pay roll at any time?

A. No; I can remember very distinctly that I never saw his name upon the pay roll.

CROSS EXAMINATION,

BY MR. GARRISON:

Q. 38. How long did you remain the mill superintendent?

A. Until April, 1915.

Q. 39. From what month in 1912?

A. From December, 1912, until April, 1915.

Q. 40. And how long after you went there did Hyde remain there?

Frank R. Wicks.

A. I don't remember having seen him around the plant after February of 1913.

XQ. 41. And when you did see him around the plant, what part of the plant was he around?

A. He generally went direct to the flotation plant.

/Q. 42. And where was that with respect to the mill?

A. At the lower end of the mill.

/Q. 43. And in the mill in the same building.

A. In the lower end of the main building.

/Q. 44. And that flotation plant was entirely under the charge of Mr. Hyde, was it?

A. No, sir.

/Q. 45. Under whose charge was it?

A. It was under Mr. Shimmin's.

/Q. 46. And he was what sort of an official?

A. He was assistant mill superintendent.

/Q. 47. You know that Hyde, of course, was paid moneys by the Butte & Superior Company for whatever he was doing, did you not?

A. No, I had no knowledge of what payment they were making on the contract.

MR. GARRISON: I move to strike out the part of the answer that is not responsive, the latter part.

MR. KREMER: We resist the motion, for the reason that the record shows that that was the only contract between him and the company.

MR. GARRISON: It is not responsive; I asked him if he knew they were paying Hyde money for whatever he was doing.

Frank R. Wicks.

THE COURT: It may be stricken after the word "no."

Defendant excepted.

Q. 48. Did you know what Hyde was doing there?
Answer yes or no.

A. Yes, I knew.

Q. 49. And whatever he was doing, he was doing under Mr. Shimmin's direction, was he?

A. No, he was never under Mr. Shimmin's direction.

MR. KREMER: Mr. Shimmin came a year later.

Q. 50. I thought you answered a few minutes ago by saying that Mr. Shimmin was in charge of the flotation plant at that time.

A. Mr. Shimmin was—I was in charge of the entire plant, and Mr. Shimmin was directly under me in the direction of the operations; Mr. Kremer is wrong there. He succeeded me as superintendent.

Q. 51. I thought you told me a few questions back that he was under Mr. Shimmin's directions.

A. No, sir; I did not intend to tell you that.

Q. 52. Under whose direction was he?

A. I don't know.

Q. 53. You know, do you not, that Mr. Hyde did not have the direction of that flotation plant at that time, don't you?

A. Yes, I know that he did not have direct charge of the operation.

Q. 54. Who did have direct charge of the operation?

Frank R. Wicks.

A. Mr. Shimmin.

XQ. 55. Whatever he did, he did under Mr. Shimmin's direction, did he?

A. I never saw Mr. Hyde do anything there.

XQ. 56. Why do you say that his presence was detrimental; do you mean the mere bulk he took up?

A. Because of his advice and conversation with the employes.

XQ. 57. Being useless?

A. Absolutely.

XQ. 58. So that, as a matter of fact, whatever was done in that flotation plant after you got there, was done by Shimmin?

A. Well, it was done by me; I was in charge of the plant.

XQ. 59. Yes?

A. But the major part of the direct operation was by Mr. Shimmin.

XQ. 60. And that plant worked on Butte & Superior ore?

A. Yes.

XQ. 61. And it was worked by Butte & Superior men?

A. Yes.

XQ. 62. And whatever avails came from it went into the same coffers as all the other moneys of the Butte & Superior?

A. I don't know where the money went.

XQ. 63. You have no reason to believe that it went to any other place, have you?

James Macdonald Hyde.

MR. KREMER: I object to that question as not proper cross examination.

Objection sustained. Plaintiff excepted.

WITNESS EXCUSED.

JAMES MACDONALD HYDE, a witness for the defendant, after being duly sworn, testified as follows:

DIRECT EXAMINATION,
BY MR. KREMER:

Q. 1. State your name.

A. James Macdonald Hyde.

Q. 2. You are the same James M. Hyde who was defendant in the case of Minerals Separation Limited and another in a case brought in this court?

A. I am.

Q. 3. And prosecuted through to the Circuit Court of Appeals and to the Supreme Court of the United States?

A. I am.

Q. 4. Mr. Hyde, when did you come to Butte the first time?

A. I came to Butte in the spring of 1911; I believe it was in the month of March.

Q. 5. What was the occasion of your visit to Butte?

A. I came as an assistant examining engineer to

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Mr. Kuehn, to make an examination of the Butte & Superior mine, I believe for Hayden, Stone & Company, of New York.

Q. 6. Did you at that time make any examination or make any tests as to whether or not the ores of the Butte & Superior Copper Company, Limited were adaptable to the oil flotation method of treatment?

A. I did.

Q. 7. By whom—For whom did you make the tests?

A. I made the tests directly for Mr. Herbert C. Hoover, who has since been chairman of the Belgian Relief Committee, and is so well known in that connection.

Q. 8. What was Mr. Hoover then?

A. He was a mining engineer and an independent operator, and in this particular business he was associated with Mr. Chester Beatty of New York, relative to ^{an} interest which Mr. Beatty and Mr. Hoover might have in a certain bond issue which was to be made. The object of my visit was nominally that of assistant examiner of mines with Mr. Kuehn. I took that position and acted in that capacity to familiarize myself with the situation so that I could determine for Mr. Hoover when the examination of the mine was over, whether or not the ores of the Butte & Superior Company could be so successfully worked as to make the bond issue probably a profitable venture.

Q. 9. Was Mr. Hoover connected with the Butte & Superior Copper Company, Limited?

James Macdonald Hyde.

A. Not to my knowledge.

Q. 10. Or any of the gentlemen mentioned by you, were they connected with the Butte & Superior Copper Company, Limited?

A. Not to my knowledge.

Q. 11. After you had made those tests, did you make a report to Mr. Hoover, Mr. Beatty and others?

A. I reported to no one but Mr. Hoover, until after Mr. Hoover had given me his permission to report to others.

Q. 12. When was that permission given, approximately?

A. My memory of the circumstances is this, that when Mr. Kuehn made his report in New York I received a telegraphic inquiry to know what results I had obtained in testing the ore by other methods than those used in the mill, and I replied that I could not inform anyone but Mr. Hoover, and that his permission would have to be obtained before I would make any report at all, and my memory is that I telegraphed Mr. Hoover asking that he give me permission—and that he gave me permission to inform Mr. Kuehn, not in definite figures, but in generalizations as to what I had learned.

Q. 12-A. Did you say anything to Mr. Kuehn?

A. I did.

Q. 12-B. Was Mr. Kuehn connected with the Butte & Superior Copper Company, Limited, if you know?

A. I don't think that he had any official connec-

James Macdonald Hyde.

tion with the company; my understanding was that Mr. Beatty was acting as a consulting engineer with Hayden, Stone & Company, as well as an associate in some business matters, and that this examination was being made for Mr. Beatty, or at the request of Hayden, Stone & Company through Mr. Beatty.

Q. 13. At that time did Hayden, Stone and Company have anything to do with the Butte & Superior direct?

A. I had no definite knowledge that they had, and understood that they had not.

Q. 14. When did you have a conversation or correspondence or communication with anyone connected with the Butte & Superior Company, Limited, upon the subject of flotation?

A. When the mine examination which I referred to was completed, I took a room at the Napton House in this town, for the purpose of having a kitchenette which would answer for a laboratory, and I tested the Butte & Superior ore there at my own expense, and bearing all of my own expenses, while my tests, ^{were} going on. I had a test machine made and tested the ore and while in the course of making my tests Mr. R. M. Atwater, arrived from New York and told me that he had there met Mr. Hoover and that Mr. Hoover had told him that I was acquainted with ore dressing in its many variations, and that he had requested me to investigate this ore and find what could be done with it, and Mr. Atwater—

James Macdonald Hyde.

Q. 15. State who Mr. Atwater was.

A. Mr. R. M. Atwater, I was informed, was the general manager of the Butte & Superior Company.

Q. 16. Proceed.

A. Mr. Atwater asked me to report to him as to the investigation that I was making and I told him that I could give no information to anybody but Mr Hoover.

Q. 17. And did you secure permission later?

A. I did not; I gave no information to Mr. Atwater at that time.

Q. 18. Well, what happened then, so that we will move along to the time when you did communicate with Mr. Atwater?

A. Mr. Atwater told me that he was going to New York, and the next that I heard was Mr. Maxwell Atwater reported to me that there had been a negotiation between Capt. Wolvin and Mr. Atwater and certain officials of the Minerals Separation Company, and that they had found, as he put it, that they would have to deed their mine to the Minerals Separation Company if they did any business with it, and he wanted to know if I could report to him at that time as to what could be done.

Q. 19. Who was this conversation with—M. W. Atwater?

A. With M. W. Atwater.

Q. 20. The same man who testified here?

A. The same man who testified here the other

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day. At that time they asked me if I would make an investigation of the subject for them. I told them I knew nothing in regard to the progress of Mr. Hoover's negotiations and would take no action in the matter whatsoever. At a later date, upon further urging on their part that something be done in the matter, I cabled Mr. Hoover—my memory is that he had gone to London—and received word from him that his relations with the matter had ceased, and that I could do anything I pleased in the matter. I had been in Butte then a considerable length of time, expecting that something would be done in that matter,—One thing I forgot to state that would show my relationship to this—When I began this investigation at Mr. Hoover's request, it was with the understanding that if he and Mr. Beatty participated in the bond issue, they would carry me for a part of the bonds, and that—by that expression I mean that they would give me an option on part of the bonds at a price, and they would hold them for me from that date at that price, so that at some later date if the bonds increased in value, I would get a profit.

Q. 21. Was that the incentive that you had in making these tests?

A. Entirely so; at the time I had no other reason for working the ore myself.

Q. 22. Now proceed.

A. After Mr. Hoover's connection had ceased, and he had so informed me, and that I could do anything

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that I pleased, and further urging upon the part of Mr. Atwater that I investigate and report to them upon the matter, I told Mr. Maxwell Atwater that I would do so upon one condition and one only, and that condition was that they should pay the expenses, and nothing more, of an investigation which would result in a study of the problem, and a determination of what could probably be done, and when I turned in that report to them they were to make me a proposition if they wanted the work done.

Q. 23. At that time was there any milling operation conducted in the United States by the use of the flotation process?

A. Not to my knowledge.

Q. 24. Did you have a general knowledge of mill operations?

A. I did. In the course of my investigations I had arrived at a practice which seemed to me different from anything that had previously been used, and I told Mr. Atwater of that fact. When I made my investigation it was on the understanding that when my report was rendered to them they should make me a proposition as to what basis they wished this work done upon, and that I would either accept or reject that proposition without debate. It was upon that basis that the investigation was made.

Q. 25. After the investigation was made by you, what if any contract did you make with the Butte & Superior Copper Company, Limited, then?

James Macdonald Hyde.

A. I entered into the contract which has been entered as an exhibit in this case.

Q. 26. You refer to plaintiff's exhibit No. 1?

A. It is so designated here.

Q. 27. Did you, at any time, have any other agreement with the Butte & Superior Copper Company save this agreement and the modification thereof, which I believe is also in evidence, verbally or in writing, having to do with your compensation for the conducting of these flotation operations referred to?

A. There was a preliminary agreement which does not appear here; I don't know that it was anywhere in writing—that during this period of investigation I was to receive absolute expenses.

Q. 28. I think that is embodied in the contract also?

A. Yes, it was embodied in the contract.

Q. 29. When I refer to the modification of that contract I refer to plaintiff's exhibit No. 1? 2

A. Yes.

Q. 30. Now, after this contract was signed and the agreement entered into, did you have any other agreement at any time with the Butte & Superior Copper Company, Limited, with reference to your compensation or remuneration for conducting any operations, save and except the modification of the contract as it appears in plaintiff's exhibit No. 2.

A. There was one verbal modification in this agreement to this extent, that as my actual expense amounted to more than \$5.00 a day, and my memorandum

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showed that they amounted to more, Mr. Atwater said it would simplify matters if the lump sum of one hundred fifty dollars (which was the maximum amount I was to be allowed) should be paid to me without question.

Q. 31. Was there any other modification of that agreement?

A. None.

Q. 32. Was there any agreement subsequently made about your compensation which was embodied in any other paper than the contract and the modification?

A. None whatsoever.

Q. 33. Now, with reference to the expense money that you have mentioned, could you tell us the cause of that modification?

A. Well, this first amount that I have referred to—I mean this first one in relation to my actual expenses, was when I was at Basin. I had my family with me, and my expenses amounted to more than \$5.00 per day, and so it was mutually agreed that instead of presenting the items and the showing of my exact expenses, that the amount would be considered to be \$150.00 per month.

Q. 34. I understood you to say in fact that they were more?

A. They were more.

Q. 35. Well—Were you ever at any time in the employ of the Butte & Superior Copper Company, Limited?

James Macdonald Hyde.

MR. GARRISON: That must be a question of law, if your honor please. He has stated what the contract was.

MR. KREMER: I asked the question with design, anticipating the objection.

Objection sustained. Exception.

Q. 36. Were you at any time under salary with the Butte & Superior Copper Company, limited?

A. Will you first tell me what you mean by salary?

Q. 37. Were you ever at any time under an agreement of employment to receive a stipulated sum over a period of time for services to be rendered by you to the Butte & Superior Company?

A. I was not—May I ask you to specify still further; do you mean by that definite amount for a given amount of time?

Q. 38. Yes.

A. I was not.

Q. 39. State to the court what your position was insofar as your arrangements with the Butte & Superior were concerned, in what capacity were you acting?

A. I acted in the capacity that is shown in this contract.

Q. 40. State it, Mr. Hyde?

A. This was a capacity in which I discharged in two stages. The first was to design and superintend the erection of and the operation of a fifty-ton test plant at Basin, Montana, operating the same for

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a period of thirty days time. Contingent upon the results of that operation, as shown by this contract, the superintendent of the company had a right to declare the result unsatisfactory and terminate all arrangements between us; and I had a right, if the results were unsatisfactory, to terminate the agreement on the basis that the increased earnings would be so slight that the compensation coming to me would be not sufficient to warrant me in giving my time to the matter.

Q. 41. Well, were you acting as one offering their services for a fixed compensation, or were you acting as an independent engineering contractor?

MR. GARRISON: I object to that, if your honor please.

MR. KREMER: Upon what ground?

MR. GARRISON: It is a question of law entirely. He has stated he was acting under a contract.

THE COURT: What conclusion should be drawn will appear from the facts, not his conclusion. The objection will be sustained.

MR. KREMER: Proceed, Br. Hyde. Was there any other stage or any other division?

A. The second stage of the operation was that if in the first stage, the test stage, the operations proved sufficiently successful so that the superintendent or executive officer of the company should determine that the company wished to pursue them, I should then plan a larger installation, supervise its installation for a period up to ninety days, giving only such portion

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of my time during this ninety days as was actually needed for the satisfactory supervision of the work.

Q. 42. During your dealings with Mr. Atwater referred to, did Mr. Atwater at any time represent to you that he had the power to enter into a contract with you?

A. Mr. Atwater informed me specifically that it was impossible for him to enter into a contract himself; that he could only draw a memorandum of agreement and submit the same to Captain Wolvin, the president of the company in Duluth, Minnesota.

Q. 43. Referring to page 135 of Mr. Atwater's testimony, I read you the following: "Q. What did he say about that? A. You mean in connection with the arrangement which he and I had made? Q. ~~44~~. Yes, in connection with the arrangement that you made with him? A. He asked as part of our agreement that the company stand the expense of any suit that might be brought against him." Did you ever make such a statement to Mr. Atwater? Did you ever make such a request?

A. I have no memory of making any such statement. The only memory that I have is that the matter of possible litigation was discussed. I don't remember whether he mentioned it, or whether I did, but I remember of telling him at that time that if the company were sued it was very natural that they should have to defend themselves, as the total amount of compensation which was being offered to me would be insufficient, of itself, to pay the expenses of a lawsuit.

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Q. 45. Was the company sued, to your knowledge, within any time, several years after that?

A. The company was not sued during any portion of the time that I was associated with the milling operations.

Q. 46. Who was sued, if anyone?

A. James M. Hyde.

Q. 47. Now, Mr. Hyde, did you make any statement to Mr. Atwater about patents which you had in contemplation?

A. I told Mr. Atwater that in the course of the tests that I had made upon the Butte & Superior ore I had demonstrated that certain novel features of treatment apparently gave better results than any type of treatment that had previously been used.

Q. 48. What did you say to him with reference to your taking out patents?

A. I told him that I was going to apply for a patent upon these improvements and that the treatment which the application got in the patent office would tend to demonstrate whether the improvements were novel.

Q. 49. Did he ask you why you took out patents on a process when you considered the patents which already existed were of no value?

A. I have no absolute, definite memory with regard to his declaration in the matter, but I know that he did ask some such question. I have a very definite memory of what my answer to it was.

Q. 50. Please state your answer?

A. My answer was this; ^{that} ~~this~~ the extended investi-

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gation which I had made of flotation patents indicated to me that the patent upon which the claims of Minerals Separation were based was invalid and that the matter in it had been entirely divulged in the United States patent granted to Carrie J. Everson, and in the British patent granted to Alcide Froment.

Q. 51. Did you answer him that you had been advised by counsel to take out that patent at that time?

A. I probably did.

Q. 52. Now, Mr. Hyde, the following I read you from the testimony of Mr. Atwater, page 139 of the record at the bottom of the page: "Q. Did you pay him a flat sum of money per day or did you pay him moneys made up of items of expenses; or both? A. We paid him so much a month." Is that true?

A. There was never any understanding that any sum of money paid on a monthly basis was compensation for services rendered. The understanding was flatly that—as is shown in the contract, which is exhibit 1—that only expenses would be allowed up to the time when the results of the work had demonstrated for themselves what might possibly be done. I will say further with regard to this matter that Mr. R. M. Atwater had requested that I make this investigation for the Butte & Superior Company upon the basis of a fixed compensation and he offered me the magnificent sum of \$10.00 per day for making the investigation. I told Mr. Atwater that the compensation was not compensation at all and I wouldn't consider the matter upon any such basis.

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Q. 53. Now, Mr. Hyde, I read you the following from the testimony of Mr. Atwater, page 140: "Q. Did you—when did you cease paying him moneys?

A. I think when he left Basin. Q. 54. And about when was that? A. That was—why, I think he received a salary after he left Basin. I will correct that. While he was working at Butte on the flotation plant here." Is that correct?

A. I have no memory of having received any regular amount of money in Butte. It is possible that the same allowance of \$150.00 per month was made.

Q. 55. Mr. Hyde, please listen to this question and answer what I ask you and as briefly as possible: "Q. And about when was that? A. That was while—why, I think he received a salary after he left Basin. I will correct that. While he was working at Butte on the flotation plant here."

A. I never received a salary under any circumstances.

Q. 56. Then that is not true?

A. It is not true.

Q. 57. Then following, the next question: "At Butte? A. At Butte, I think he received so much a month." Is that true?

A. I haven't any memory of having received any fixed stipulation at Butte.

Q. 58. Well, you would have a recollection, wouldn't you, if you had?

A. I think I would.

Q. 59. Well, do you know whether you would or

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not, Mr. Hyde? Do you remember receiving the money?

A. Well, my memories in regard to the matter are simply that I received this allowance up to five dollars a day of 'expense money' while at Basin and only expense money that came from my expense incurred in other ways afterwards.

Q. 60. Have you examined the copies of the vouchers set forth in the table of exhibits?

A. Only very cursorily.

Q. 61. Have you, Mr. Hyde?

A. I have.

Q. 62. Do you recollect receiving the sum specified in those vouchers?

A. They seem to be sums which I have received.

Q. 63. Do you desire to comment upon any of them, Mr. Hyde?

A. Why, those that I recognize are for expenses incurred in traveling. They are not for expenses—and I see an item for the Thornton Hotel which is one of the visits which I made to Butte.

Q. 64. I deliver to you for inspection and comment defendant's exhibits 166, 167, 168, 169, 170, 171, 172, 173, 174 and 175, and I will ask you, Mr. Hyde, to briefly comment upon any one of these that you desire to mention specifically.

A. The first one at hand is voucher defendant's exhibit 166, expense account for July, 1911, at \$5.00 per day, one third payment on test machine \$10.00. The next one is exhibit—

James Macdonald Hyde.

MR. GARRISON: These are all described in the minutes.

(Question read as follows: "I deliver to you for inspection and comment defendant's exhibits 166, 167, 168, 169, 170, 171, 172, 173, 174 and 175, and I will ask you, Mr. Hyde, to briefly comment upon any one of these that you desire to mention specifically.")

MR. KREMER: Any one of them, if there is any one of them that you think needs any comment?

A. I see none of them that needs comment.

Q. 65. I hand you defendant's exhibit 176 and ask you if there are any comments you desire to make upon that?

A. This is for an expense account you see.

Q. 66. Did you receive the expense account?

A. I have no definite memory of so doing but as it is my signature I have no doubt that I did.

Q. 67. Now, proceeding, Mr. Hyde, I will ask you in what countries, if any, you have procured letters patent, of your patent 1022085?

A. Letters patent were issued to me in the United States, and upon the equivalent subject matter in Canada, Mexico and Australia.

Q. 68. In Australia, did you say?

MR. GARRISON: He did.

A. Yes.

Q. 69. MR. KREMER: Do you know whether flotation operations had been conducted or originated in Australia long before the filing of your patent?

A. There had been.

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Q. 70. To what extent do you know?

A. The principal development of the art previous to 1911 took place in Australia.

Q. 71. Now, Mr. Hyde, what, if any, other agreement did you have with the Butte & Superior Copper Company, Limited, if any, than the ones you have referred to here?

A. I had a certain agreement with the Butte & Superior Company made after I was sued for infringement of United States patent 835,120, that for and in consideration of the granting to them any rights that I might obtain by United States patent to the procedure that I was using in treating ores, and for the further consideration of not competing in any way with them in the Butte district, they would pay the expenses of the litigation.

Q. 72. For whom?

A. For me.

Q. 73. Was there any other consideration of the license or right which you refer to than the consideration of the paying of the expenses of your litigation?

A. No. They were to pay the expenses of the litigation and of myself in travelling during the litigation.

Q. 74. Who had the direction or handling of your litigation?

A. I did personally.

Q. 75. Did the Butte & Superior Copper Company, Limited, or the Butte & Superior Mining Company at any time have direction or control of the suit of *Minerals Separation, et al. vs. James M. Hyde*?

James Macdonald Hyde.

A. They did not.

Q. 76. Please state to the court who, if anyone, had the right to withdraw your defense in the suit of Minerals Separation, Limited, et al. vs. James M. Hyde?

A. There never was anyone who had that right but myself.

Q. 77. Who, if anyone, had the right to make a settlement or adjustment of the controversy existing between yourself and Minerals Separation, Limited, et al., as set forth in the suit of Minerals Separation, et al. vs. James M. Hyde?

A. No one but myself.

Q. 78. Who, if anyone, had the right or authority, aside from yourself, to direct the method of manner of procedure or the litigation in the case of Minerals Separation, et al., v. James M. Hyde?

A. No one.

Q. 79. What, if any, connection did the Butte & Superior Copper Company, Limited, or did the Butte & Superior Mining Company have with the suit of Minerals Separation, et al., vs. James M. Hyde, that being the case that I have constantly referred to as having gone to the Supreme Court?

A. They had no connection with it whatever, other than referred to in the contract with me to pay the expenses of the litigation, which I have mentioned.

Q. 80. Did they so pay the expenses?

A. So far as I know they did.

Q. 81. Who had the direction and control of the lawyers representing you in the case of Minerals Separation, et al., v. James M. Hyde?

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A Counsel were selected by myself personally, and the counsel informed me that to a very unusual degree I set with them at all times directing the line of questions that should be asked and worked out the line of tests that should be introduced in evidence.

Q. 82. Did anyone purporting to be the representative of the Butte & Superior Mining Company give counsel or direction, to your knowledge, to your lawyers; or did you do so yourself, exclusively?

A. To my—I have no knowledge of anyone but myself ever counselling them as to what course of action should be taken.

Q. 83. You engaged as one of your lawyers a practitioner who also represents the Butte & Superior Copper ^{Company} Limited, did you not?

A. I did.

Q. 84. I wish you would state the circumstances of that employment?

A. When the Butte & Superior Company agreed, for the compensation which I have mentioned to bear the expenses of the suit, I went to Mr. J. Bruce Kremer of Butte and asked him if there was any reason why he could not represent me as counsel. He replied that there was not. I asked him if there were any reasons in his connection with anyone that would in any way interfere with his representing my interest as though they were the sole interests that he represented in his whole practice and he said that so far as this litigation was concerned there was not. I thereupon retained him to act as counsel for me in this litigation.

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Q. 85. Did you engage anyone else?

A. I did.

Q. 86. Who?

A. I engaged the firm of Sheridan, Wilkinson, Scott & Richmond.

Q. 87. Under what circumstances?

A. I discussed the matter with Mr. Kremer and asked him what he would advise in the circumstances and he told me of the fact that he was a corporation attorney and in the general practice of law, and was not in any sense a patent attorney, and that he would feel no more competent to undertake the work of the defense of a patent suit than he would to engage in the practice of the Admiralty law; and he suggested that we find out who would be best equipped to represent us in this particular matter. When I say "us" I mean myself as client and he as counsel. He made inquiry from Mr. D. C. Jackling, a man of great ^{experience} ~~prominence~~, and Mr. Jackling suggested that he had known Mr. Sheridan very favorably, and we made a trip to Chicago. Mr. Sheridan being away we discussed the matter with Mr. Walter A. Scott. I remember after our interview with Mr. Scott we retired and discussed the matter between ourselves, and as a result of our discussion we decided that he seemed to be a man who was particularly equipped to conduct the defense of an action of this kind.

Q. 88. And that was then the beginning of the employment of all of your counsel?

A. Yes, sir.

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Q. 89. From that time on who directed the conduct of your case to these counsel?

A. I did personally.

Q. 90. Could you at any time, Mr. Hyde, of your own volition, have discharged any and all of your counsel and employed new ones?

A. There was no time up to the present time when I could not have discharged counsel and taken new ones; and it is ~~not~~^{my} right today and my sole right to appeal for a rehearing of my case in the Supreme Court and to retain as my counsel there either the learned counsel whom I have had or any other counsel whom I may select.

Q. 91. Now, Mr. Hyde, there is among the exhibits some correspondence with reference to the matter of your settlement and adjustment with the Butte & Superior Copper Company, Limited, of the amount due you or claimed to be due you under the contract in evidence. I wish you would briefly explain that correspondence. I think you have examined the documents?

A. The principal document here is a letter from James M. Hyde addressed to N. B. MacKelvie.

Q. 92. Just give the number of the exhibit so opposing counsel can follow it.

A. That is a letter appearing upon page 25 of the volume of exhibits which I have here in hand. It is dated July 15th, 1913.

MR. KREMER: You needn't read it all, Mr. Hyde, if you have read it.

James Macdonald Hyde.

A. This is a very full statement and it seems to me needs very little elucidation. It is a complete statement of the history of the relations between myself and the Butte & Superior Company, of the conditions which we recognized in the work and throughout my relation to the company is always referred to on the basis of the contract, the contract being that which was introduced here as an exhibit.

Q. 93. Was there any difficulty between yourself and the company, or in the controversy between yourself and the company as to the settlement of your compensation?

A. There was.

Q. 94. Please state the circumstances surrounding that?

A. The original agreement—

Q. 95. Just briefly, Mr. Hyde?

A. (Continuing)—was entered into upon a basis that a 90 day period of work at Basin, on the basis of certain experiments being made and certain machinery, should really bring our agreement to a termination, and the company did not see fit to carry out the agreement and install the machinery that was called for at Basin. Therefore, the final adjustment had to be deferred until after the mill was built in Butte and put into such shape that it carried out the recommendations that had originally been made for Basin. There was considerable delay in carrying out these recommendations.

Q. 96. And upon the matter of settlement?

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A. The matter of settlement was a matter of a number of conferences, one of them taking place here in the city of Butte, in which Mr. J. Bruce Kremer represented the Butte & Superior Company, telling me at that time that I must recognize while he was my counsel in the patent matters that in the matter of this agreement with the company which had been specifically referred to him by Mr. MacKelvie, he was the counsel for the Butte & Superior Company and would have to act in their interest.

Q. Did he make any suggestion to you as to the employment of other counsel?

A. He made the suggestion to me at that time that if I felt if it was necessary for me to take any legal action, he would advise it would be necessary for me to have other counsel and he recommended to me, not in his capacity as an officer of—officer representing the Butte & Superior Company, but in his personal capacity as a friend, that the argument be settled, not upon the basis of the contract, but upon a mutual understanding taking everything into account.

Q. 97. You say as “an officer of the company”.

A. I mean as counsel for the company.

Q. 98. And was that done ultimately?

A. Yes, that was done ultimately.

Q. 99. And a satisfactory adjustment was made?

A. A satisfactory adjustment was made.

Q. 100. Now, Mr. Hyde, you stated that this arrangement was made between yourself and the Butte & Superior Company with reference to the defense of this suit. With whom did you make that contract?

James Macdonald Hyde.

A. That contract was made with Captain Wolvin personally, he being at that time president of the Butte & Superior Company.

Q. 101. You further state, I think, that it was in consideration of the settlement—of the assignment of certain rights. Did you actually make an assignment?

A. That assignment was made after the patent was duly granted.

Q. 102. And recorded in the Patent Office?

A. So far as I know it was. I instructed my counsel to record it.

Q. 103. Now, Mr. Hyde, it is averred in the pleadings here that your patent No. 1022085 for the concentration of ore and retreatment of concentrates, is a sham patent and that it discloses no invention. I will ask you to state whether that patent is a patent of practical utility?

A. I had a rather unusual experience in applying for that patent in that I went in person, with Mr. Scott, to the patent office and took the matter up with Mr. Mitchell, who was examiner in that division, and Mr. Mitchell told me at the time of our first talk with him—

MR. GARRISON: I hardly think we ought to have what Mr. Mitchell told him.

MR. KREMER: You needn't state what Mr. Mitchell said. You can state what you did.

A. The matter was presented there in person and was granted very shortly. The patent covers two main features of operation, one being the use of sul-

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phuric acid, not in the manner in which it had been previously used, that of adding it directly in large quantities into the machine, but of adding a much smaller equivalent, allowing a space of time to elapse so that the smaller amount, acting in the more dilute solution, would have a greater length of time in which to perform its function, and bringing the pulp to the machine and treating it. It covered a second matter, that not of—as has been represented—not the practice of retreatment but of a special method of retreatment and cleaning of the concentrate, that special method consisting of the running of the pulp through a machine in which the attempt was made to eliminate and save the concentrate, the sulphide, as completely as possible, without regard to the commercial grade of the concentrate, and the then taking of that low grade of concentrate from the first machine, which was, because of its function, called a rougher, and taking the concentrate to a second machine and therein making a high grade concentrate. This method was described in the patent in detail as being one in which the water level in the rougher should be kept at such a level that the concentrate would overflow most rapidly and most completely, even if some of the water and slimes overflowed with it. And in the second machine to maintain the water level at so low a point that only the concentrates would overflow, The tailings from the first machine being returned to the first or the recleaner or a grinding device before coming back for retreatment. This patent occupies a peculiar position in

P. 3973, L. 28, insert "procedure? A. The matter of procedure that was outlined and carried on in this machine. Q. 107. Well, not in any detail, Mr. Hyde. It is in the letter; But what I wanted particularly was the matter of " after " of "

P. 3972, L. 5, insert “ amount of sulphuric acid or some ”
after “ smaller ”

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the many patents which have been granted in the flotation work insofar that it is more specific in its disclosure; gives more instructions which can be followed by a millman, and in the body of the patent relates results which have actually been accomplished in the operation of the patent upon a commercial scale.

Q. 104. Where was that being operated; where was it operated?

A. That process was first operated, to my knowledge, at Basin, Montana, and so far as I know, has been continually operated by the Butte & Superior since that time.

Q. 105. Now, Mr. Hyde, did the company ever make any arrangement with you or ever in any manner or form agree to hold you harmless in damages in any litigation or in connection with any litigation?

A. The company did not, and it was a matter of great personal relief to me—

MR. GARRISON: I object, if your honor please, to his state of mind. I can't see that that is material.

THE COURT: I think you have answered the question.

A. There was one point of procedure, you asked me to discuss this here. Do you wish one comment upon it?

Q. 106. MR. KREMER: What was that, in the matter of your settlement and adjustment? I read you from the testimony of Mr. Atwater: "Q. Could you discharge or could you have, in your judgment, have discharged Mr. Hyde? A. Yes. Q. As an employer?

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A. Yes, at that time I could have. Q. Upon what basis do you make that statement, the contract? A. I based it upon the fact the president asked me why I didn't tell him, the president of this company." At any time did Mr. Atwater ever say to you that he could discharge or employ you?

MR. GARRISON: I object. There isn't the slightest intimation in Mr. Atwater's testimony that he conveyed any such suggestion to this witness.

THE COURT: I think the witness Atwater testified he could discharge him and then gives a reason which shows that he couldn't. It looks that way.

MR. KREMER: With that in mind, if that is the interpretation, I am perfectly willing to let it rest. I wanted to ask him because I thought there might be a question about it.

THE COURT: You may ask the question if you desire, if he could have discharged him?

MR. KREMER: Could he have discharged you?

A. He could not. There was nothing to discharge me from. I was carrying out a contract.

MR. KREMER: May it please the court, I offer in evidence an assignment, a certified copy of an assignment, of patent, the rights to patent 1022085, as testified to by the witness, this being a certified copy of the patent, of the rights in patent 1022085, filed in the patent office of the United States. Any objection?

MR. GARRISON: No.

Assignment of patent admitted in evidence and marked DEFENDANT'S EXHIBIT 232.

James Macdonald Hyde.

Q. 108. MR. KREMER: Mr. Hyde, I offer you defendant's exhibit 178, a part of which is composed of a purported copy of a telegram sent to you by N. B. MacKelvie from Berkeley, California, reading as follows: "Have received word of decision from Kremer but no details. I take for granted that appeal will be filed. Am at your service for any conference the occasion may require. Will expect matters under discussion to be held in abeyance until new and unexpected situation is taken care of. (Signed) James M. Hyde, telegram dated July 30th, 1913." I will ask you to examine that telegram and instruct the court to what it refers?

A. I judge from the date of this that it refers to the decision of the Montana District Court in question. The only way I can comment upon this thing is by giving my state of mind which has been objected to.

Q. 109. No. don't give your state of mind, but you can state what you meant by it.

MR. GARRISON: I don't know, if your honor pleases.

MR. KREMER: Oh, yes.

MR. GARRISON: Just a minute. I will address the court. I object to this witness testifying what he meant unless there is something obscure. Of course if there is some word that is obscure that is another matter. We are quite as competent to tell what a man says as he is.

MR. KREMER: We have a right to explain.

THE COURT: There is nothing in it to explain.

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MR. KREMER: What it refers to, this line, it doesn't mean anything.

THE COURT: He has already said it referred to the decision of this court, which apparently or possibly came about that time. The objection will be sustained.

MR. KREMER: Exception.

Q. 110. What is meant by the statement with reference to appeal?

THE COURT: Oh, well, that shows for itself. We all know that there was an appeal.

MR. KREMER: There was an appeal but that is not in this record, the statement as to his directing the appeal.

THE COURT: You may ask him in reference to that whether he did direct the appeal.

Q. 111. MR. KREMER: Referring to the appeal mentioned in that telegram, who directed that appeal to be taken?

A. I did.

MR. KREMER: That is all.

CROSS EXAMINATION,
BY MR. GARRISON:

X-Q. 112. When did you leave the employ of the Minerals Separation, Limited?

MR. KREMER: I object to that as not proper cross examination. There is no testimony in this record that Mr. Hyde was ever in the employ of the Minerals Separation, and he was asked no question about that on direct examination. It is improper cross examination.

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THE COURT: So far as the court can see, it would seem to be.

X-Q. 113. MR. GARRISON: Were you ever in the employ of the Minerals Separation, Limited?

MR. KREMER: I object to that as incompetent, irrelevant and immaterial, having no bearing upon the issues in this case and not proper cross examination.

THE COURT: It might be the relation between the parties. I assume counsel has some object.

MR. GARRISON: I will not consume more than a few moments of the preliminary question.

THE COURT: Objection overruled.

MR. KREMER: Exception.

A. I was.

X-Q. 114. MR. GARRISON: And when did you leave their employ?

MR. KREMER: We object. I suppose all of this will go in under our same objection?

THE COURT: Yes.

A. So far as I remember it, it was the last of January, 1911.

X-Q. 115. And where were you at that time?

A. I was in the city of London, England.

X-Q. 116. Which was the headquarters of the Minerals Separation, Limited, was it not?

A. It was at that time.

X-Q. 117. And you then came from there to what part of this country?

MR. KREMER: Now, we renew our objection to that unless some reason is disclosed, for the purpose

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of showing animus. I do not see where it could have any other bearing than that.

THE COURT: I think you may proceed. This is cross examination. To give your reasons does not apply as it does on direct. He has a right to show the relation and attitude of this witness to the parties. The objection will be overruled.

MR. KREMER: Exception.

MR. GARRISON: I merely asked him where he came to in this country.

THE WITNESS: At that time I remained in London.

MR. GARRISON: Read what I said please?

(Question read as follows: "And you then came from there to what part of this country?")

X-Q. 118. MR. GARRISON: You couldn't remain in London and come from there. I asked you after you left London?

A. As I understood the question was as to—

THE COURT: Answer the question.

A. From where?

X-Q. 119. MR. GARRISON: Where did you come to when you left London?

A. I came to New York.

X-Q. 120. And from thence where?

A. I came from thence to Butte, Montana.

X-Q. 121. And when did you get to Butte?

A. I don't remember the date definitely, but it was some time in March or April.

X-Q. 122. Of what year?

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A. 1911.

X-Q. 123. And how long were you engaged in the investigation in which you assisted Mr. Kuehn?

A. I have no definite memory of the length of time, but it was some two or three weeks.

X-Q. 124. And were you through the employment in which you had been engaged, assisting Mr. Kuehn in whatever investigation he was making?

A. I was.

X-Q. 125. And you remained in Butte then as I understand it, after that time?

A. I did.

X-Q. 126. And during that period were you making these experiments that you speak of with the Butte & Superior ore, to see whether it was a subject of flotation?

A. As I have testified I was making those experiments.

X-Q. 127. After you and Mr. Kuehn got through and during the time that you remained in Butte?

A. I was.

X-Q. 128. Did you bring a slide machine with you or did you have one constructed here?

A. I had one constructed here.

X-Q. 129. Did you bring one with you?

A. I did not.

X-Q. 130. About when did you have your first interview with Mr. Maxwell Atwater, of which you have testified?

A. While I was making the mine examination I

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was meeting Mr. Maxwell Atwater every day, and I have no definite memory when the subject was first mentioned.

X-Q. 131. You have stated that you first had a conversation concerning negotiations with the Butte & Superior with Mr. R. M. Atwater, have you not?

A. I have.

X-Q. 132. And that subsequently you took the matter up with Max Atwater?

A. I have.

X-Q. 133. When was it that you took the matter up with Max Atwater?

A. It was some time subsequent to my conversation with Mr. R. M. Atwater, Mr. R. M. Atwater then not being in Butte.

X-Q. 134. I ask you when it was.

A. I have no definite memory when it was.

X-Q. 135. It was prior to the contract of July ²nd, 1911, wasn't it?

A. It was.

X-Q. 136. Had you any contractual relations of any kind, sort or description with the Butte & Superior Copper Company prior to the contract of July 22nd, 1911?

A. Yes.

X-Q. 137. What previous or other contract had you had with them?

A. I had an agreement with them by which I would make an investigation, for actual expenses, and report to them what probable recovery could be obtained from their ore.

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X-Q. 138. When did you make that contract?

A. I have no definite memory, but it must have been in May, I should say, probably.

X-Q. 139. How long did that take you?

A. That took me some week or ten days' time.

X-Q. 140. And you were paid your actual expenses during that time?

A. And nothing more.

X-Q. 141. And that was all through before June, was it?

A. It was.

X-Q. 142. And after that did you have conversations with Mr. Max Atwater about your entering into some other contractual relation with the company?

A. I have no memory of entering into any conversation with him in regard to any other contractual relation with the company than what is set forth in this contract in evidence.

X-Q. 143. Conversations are not set forth in that contract.

MR. GARRISON: Read the question.

MR. KREMER: I object. This is not a proper question. It is not a question at all.

THE COURT: I think that the former question was fairly answered.

X-Q. 144. I understood you that you had some sort of contract with the company that you were to receive your actual expenses while you made some investigations in the month of May, 1911; is that correct?

A. It is.

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X-Q. 145. That took you about ten days?

A. That is my present memory.

X-Q. 146. And you were paid your actual expenses for those ten days?

A. My actual expenses.

X-Q. 147. Did you after that time have conversations with Mr. Max Atwater about entering into ~~same~~ other contractual relation with the company. This can be answered, it seems to me, yes or no.

A. Yes.

X-Q. 148. You did?

A. Yes.

X-Q. 149. Now, during that time did you take up with Mr. Max Atwater the patent situation, the Minerals Separation patent situation?

A. I have no memory of going into it with him in any detail.

X-Q. 150. Mr. Nutter was here representing Minerals Separation Company and trying to get the Butte & Superior to enter into a contract with his company, wasn't he?

A. He was. I don't say that from anything more than the knowledge of what Mr. Nutter told me, that he was.

MR. KREMER: We move to strike out the answer as improper, not being from any knowledge of the witness, and being mere hearsay.

THE COURT: It may be stricken.

X-Q. 151. Did you or did you not know that Minerals Separation Company was trying to get the Butte

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& Superior Company to take a license from it at that time; did you or did you not know at that time?

A. I had not any definite knowledge in the matter.

X-Q. 152. Did you have some indefinite knowledge?

MR. KREMER: That is objected to as argumentative. If he has no definite knowledge he can have no knowledge.

THE COURT: Well, I granted the motion to strike that, but if it is merely to bring home to this witness the fact that he had information that negotiations were pending, I think it is proper and the objection will be overruled.

MR. KREMER: I will take an exception, if the court please. I desire to make the further objection that the question is argumentative, and does not convey to the witness anything which he could answer. Who is going to judge whether his knowledge is definite or indefinite?

MR. GARRISON: The witness.

THE COURT: He may answer.

Defendant excepted.

THE COURT: He left the inference that he had such knowledge, when he qualified his former answer.

X-Q. 153. Did you have any indefinite knowledge?

A. I did.

X-Q. 154. You knew Mr. Nutter?

A. I did.

X-Q. 155. You met him there?

A. We lunched together and talked over a good many matters.

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X-Q. 156. You knew he represented the Minerals Separation Company, Limited?

A. I did know that, yes, sir.

X-Q. 157. Then, as a matter of fact, based on such facts as we commonly base our every-day transactions on in life, you knew he was here trying to get that business, didn't you?

MR. KREMER: That is objected to as argumentative, interpolating the matter about what we base our every-day actions in life on.

Objection ~~sustained~~ *overruled*

A. The basis of my knowledge was that Mr. Nutter asked me what he should do under the circumstances.

X-Q. 158. And you knew in a general way that he was here trying to get them to enter into a contract with his company, didn't you?

A. I did.

X-Q. 159. Now, you disclosed to somebody representing the Butte & Superior that there were these patents in the offing, didn't you?

A. I have no definite memory as to what was said on that matter. I know that the subject was mentioned.

X-Q. 160. And of course you mentioned it, didn't you?

A. I believe that Mr. R. M. Atwater first mentioned the subject to me, and told me that he had received information in New York that the patents were invalid.

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X-Q. 161. You talked over with him whether ~~they~~ they were valid or not, didn't you?

A. I did.

X-Q. 162. And you talked it over with Mr. Kremer, didn't you?

A. I have no memory of talking it over with Mr. Kremer. I met Mr. Kremer only in the matter of making this contract.

X-Q. 163. You never met Mr. Kremer until you met him in connection with that contract?

A. That is my memory.

X-Q. 164. And up to that time had there been any other local counsel or attorney of the Butte & Superior with whom you had come in contact?

A. None.

X-Q. 165. Was the firm of which Mr. Kremer is a member the only local counsel of the Butte & Superior with whom you ever came in contact?

A. It was.

X-Q. 166. Now, to your knowledge did not the company refer the matter of the patent phase of this situation to Mr. Kremer?

A. I have no memory in the matter whatsoever.

X-Q. 167. And you never did have any knowledge to that effect?

A. I never did. ~~I do not remember of having had any knowledge of the matter.~~

X-Q. 168. And you never had any knowledge that Mr. Kremer had referred the matter to a firm of prominent patent lawyers, did you?

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A. (I never did.) ~~I do not remember of having had any such knowledge.~~

X-Q. 169. And he never told you who they were, did he?

A. I do not remember that he ever told me that he had referred any matter to any firm.

X-Q. 170. Did he ever tell you whether he had reached any conclusion as to whether there was any danger of litigation from Minerals Separation if they used this process?

A. I have no memory that he ever did.

X-Q. 171. Don't you remember that he never did?

A. No, I cannot say that I remember that he never did.

X-Q. 172. What is the state of your memory about that?

A. It is simply that I remember nothing in regard to the matter.

X-Q. 173. Is that your signature?

A. It appears to be.

X-Q. 174. Well, is it?

A. Well, all that I can say is that it appears to be.

X-Q. 175. That is the best that you can say after looking at it?

A. I think it is my signature.

X-Q. 176. Have you any doubt about it?

A. No, I have not.

X-Q. 177. Why don't you say frankly that it is your signature, then?

MR. SHERIDAN: I object to this attempt to bluff the witness, if the court please.

James Macdonald Hyde.

MR. KREMER: He can't bluff him.

THE COURT: No, I don't think it is bluffing. If the witness is confronted with his signature he ought to know whether it is his or not.

A. I have no doubt that it is my signature.

MR. GARRISON: I offer this in evidence.

MR. KREMER: We object to it as incompetent, irrelevant and immaterial and tending to prove no issue in this case and in no wise binding upon this defendant. This is a letter written by Mr. Hyde to Mr. W. A. Clark, Jr. It is not binding on the defendant.

THE COURT: It is in connection with his testimony as to what he was doing at the time. The objection will be overruled.

Defendant excepted.

Letter referred to admitted in evidence marked
PLAINTIFF'S EXHIBIT No. 233.

X-Q. 178. After you had talked to Mr. Max Atwater, after these preliminaries in May had been disposed of, did you and he reach an understanding?

A. The understanding which—

X-Q. 179. Answer my question yes or no; did you and he reach an understanding? Now, you either did or you didn't.

A. We did.

X-Q. 180. And in the course of those conversations with Mr. Atwater did you suggest to him that if suits were brought in connection with the introduction of

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this flotation process, that the company must take care of them?

A. I have no memory in regard to that, other than what I testified to on direct examination, that it has been in my mind that I told him that if the company were sued—I had no thought at the time of anybody but the company being sued—that if the company were sued that they would naturally have to defend themselves.

X-Q. 181. Naturally. It was not to be expected that you would finance the company, was it, that was not expected by you or by them?

A. There was no expectation in the matter.

X-Q. 182. Now, the thing that you really were talking about was in case suit was brought against you, wasn't it?

A. It was not, no. It was an utter surprise to me when the suit was brought against me personally.

MR. GARRISON: I object to this being a surprise to him.

MR. KREMER: He asked him what he thought.

MR. GARRISON: No, I didn't.

THE COURT: Wait a minute; repeat the question and the answer. The answer may be stricken out, after the words "it was not."

X-Q. 183. Do you mean to say that you and Mr. Atwater, or you and Captain Wolvin, if you ever had any conversation, did not talk about what would happen if suit were brought against you?

A. I have no memory of that matter ever being brought up.

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X-Q. 184. Then the understanding you had of it with them was that if these threats of litigation were made good, that they would have to take charge of it and pay for the expenses thereof, is that right?

A. If they were sued.

X-Q. 185. Now, that you talked over with Mr. Atwater, did you?

A. I have no definite memory about the matter.

X-Q. 186. Don't you remember getting Mr. Atwater to write a letter stating that that was what you insisted upon, and that you would not enter into any contract until that was understood?

A. I really have no memory of any such letter.

X-Q. 187. Well, do you remember that you had a thorough understanding about that before you would enter into any other contract with them, don't you?

A. No, I don't remember that.

X-Q. 188. Well, do you have any memory at all of ever having talked this over with anybody?

A. My memory is what I have stated it to be, that the matter was discussed, and that as far as I have any memory at all, it was entirely upon the basis that if they—

X-Q. 189. I did not ask you that; I ask you if you do remember talking it over with somebody, and you say you do.

A. I remember the subject having been mentioned.

X-Q. 190. Who do you remember having mentioned it with?

A. I discussed this matter—I mean my whole rela-

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tionship was discussed, as far as I remember, only with Mr. R. M. Atwater or Mr. Maxwell Atwater.

X-Q. 191. Then you did talk it over with one of them—one or the other of those gentlemen?

A. I presume it was mentioned to one or the other.

X-Q. 192. And was it one or the other of those gentlemen to whom you conveyed the information that if suit was brought against the company, as you say, that they must pay the expenses of it?

A. I have no definite memory in the matter outside of that I have a feeling that there was such a conversation.

X-Q. 193. And you have stated that in that conversation you said that if suit was brought against the company that they would have to bear the expense thereof; that is what you have said?

A. I think you misquote me.

X-Q. 194. Well, I won't misquote you. What did you say?

A. I say that I have a hazy memory that the subject was discussed, and my memory is that it was a subject of discussion as I have expressed it.

X-Q. 195. Now, is that the only conversation that you ever had with anybody representing the Butte & Superior Company about the payment of the expenses of litigation?

A. No, there is the one which led to the agreement that on the assignment of my patent rights they would assume the expense of the litigation.

X-Q. 196. And about when was that?

James Macdonald Hyde.

A. That was some time in October. The exact date is, as I remember, that of one of the letters which is here^{as} an exhibit.

X-Q. 197. October of what year?

A. 1911.

X-Q. 198. Immediately after the suit was brought, or before?

A. I think that it was about one week after the suit was brought.

X-Q. 199. And who did you have that understanding or agreement with?

A. With Captain Wolvin, the then president of the company.

X-Q. 200. You had not applied for any patents at that time, had you?

A. It was—

X-Q. 201. No, no, answer my question.

A. I don't remember the date of my application for patent.

X-Q. 202. Well, let us get the date of your application for patent. I show you the official records of the Hyde suit. Is this the patent about which you have been speaking, No. 1,022,085?

A. It is.

X-Q. 203. That has a legend on it, "Application filed November 10th, 1911," hasn't it?

A. It has.

X-Q. 204. Now, that is the patent that you agreed with Captain Wolvin in 1911 that you would assign him an interest in, is it?

James Macdonald Hyde.

A. It is.

X-Q. 205. The egg had not been laid, much less the chicken hatched, at that time, had it?

A. The process was in operation—

MR. KREMER: I move to strike that expression about the egg; I don't think that is proper.

MR. GARRISON: I will strike it out myself. It is a little too obvious, to need stating.

X-Q. 206. Who else was present when you had this conversation with Captain Wolvin?

A. I had two conversations with Captain Wolvin on this subject. The first one was in the office of the Butte & Superior Company, and there were present one or more—I think either two or three of the then directors of the company, who were present from Duluth.

X-Q. 207. You knew, when you installed or started to install, or started to make available for the benefit of the Butte & Superior the knowledge that you had of flotation, that a patent suit would be brought by Minerals Separation against somebody or other to try to stop that, didn't you?

A. That was an impossibility, my having such definite knowledge.

X-Q. 208. I call your attention to page 38 of the book that you have there in your lap, which is Plaintiff's Exhibit No. 8, a letter written by you to the president of the company, Mr. MacKelvie, under date July 15th, 1913. You did not have any hesitancy there—to show what a positive state of knowledge you had.

James Macdonald Hyde.

You said "The fact that a suit would result from proceeding to use a flotation process was known to all concerned." Weren't you one of the persons concerned?

A. I was.

X-Q. 209. Then you knew it, didn't you?

A. I did not know it in the sense that I could swear to it in a court of law.

X-Q. 210. Oh, I see you draw a distinction there—

Whereupon further hearing was adjourned until Monday, May 7th, at 10 a. m.

Monday, May 7, 1917, 10 a. m.

JAMES MACDONALD HYDE resumed the stand for further

CROSS-EXAMINATION.

THE WITNESS: If your honor pleases, if it is permissible I would like to correct my testimony in a few places where I see I was in error on Saturday, in testifying from memory with regard to things six years ago. Page 1929, question 84, in answer with regard to the employment of Mr. Kremer as counsel, I find that I was mistaken as to the date, that it was some time preceding August 18, about the middle, some time preceding the middle of August.

X-Q. 211. MR. GARRISON: What year?

A. 1911. On page 1949 and going on to page 1950 my answer to question 167 should have been: "I have no memory in the matter whatsoever."

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X-Q. 212. MR. GARRISON: You said here, "I have knowledge in the matter."

A. I should have said "I have no memory in the matter." The next question I said I never did, where I should have said "I don't remember having had any knowledge of the matter." The next question I said I never did where I should have said "I don't remember of having—

MR. GARRISON: I don't understand that this is correcting his testimony.

THE COURT: I think so.

MR. GARRISON: He says in answer to a question, that he never did. Now he says he should have answered it another way.

THE COURT: I think he has a right to say he made a mistake.

MR. GARRISON: I thought he was merely correcting his English.

THE WITNESS: No, I meant to say I made a mistake. 168, where I said I never did, I should have said "I don't remember of having had any such knowledge. 169 I say, "He never told me that he had referred any matter to any firm." I should have said "I don't remember that he ever told me that he had referred any matter to any firm.

X-Q. 213. MR. GARRISON: Is that all?

A. Yes, sir.

THE COURT: You may proceed with the cross-examination.

X-Q. 214. I don't think that you have stated your residence and occupation. Will you please do so?

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A. My present residence is Palo Alto, California, and I am a mining engineer.

X-Q. 215. And did you come here upon this occasion, the occasion of this trial, of your own impulse, or were you requested to come?

A. I received a telegram requesting me to come.

X-Q. 216. Someone representing the defendant?

A. Yes.

X-Q. 217. And how long have you been here?

A. I think I got here at the end of the first week of the trial. I don't remember the date.

X-Q. 218. You have been here for two or three weeks?

A. Yes.

X-Q. 219. When was the experimental plant at Basin finished?

A. I think it was in June.

X-Q. 220. The experimental plant?

A. Either June or July.

X-Q. 221. Well, if that is so, I will have to clarify my memory and your own testimony respecting the preceding events. Is it correct that your first contractual arrangements with the Butte & Superior were some time in May of 1911 when you made some tests of their ore to see what results you could get from that?

A. That is as I remember it.

X-Q. 222. And that was all done in the month of May?

A. As I remember it.

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X-Q. 223. And your understanding was that if, upon your report of the results of these tests, they chose to make a proposition to you, you would say yes or no to their proposition?

A. That was the understanding.

X-Q. 224. And that proposition is what is contained in the contract of July 22nd, 1911?

A. If that is the date of it, it is possible that the events took place in June rather than in May.

X-Q. 225. That what events took place in June rather than in May?

A. The testing of the machinery upon which—I mean the testing of the ore upon which the original report was made.

X-Q. 226. Well, now, I want to get that out of the way; that is done and ended?

A. All right.

X-Q. 227. And as a result of that they made you a proposition which was represented in the contract of July 22nd, 1911, isn't that correct?

A. That is correct.

X-Q. 228. Therefore your second employment was—or if you don't like the word "employment" your second contractual relations with the Butte & Superior dated from the written contract, did it not?

A. That is true.

X-Q. 229. And that written contract is dated July 22nd, 1911, is that correct?

A. Yes.

X-Q. 230. Now, when was the experimental plant

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built under the contract of July 22nd, 1911, finished?

A. My memory of the matter has been that this took place in the month of June and July; it may be that that contract was not signed—and I think that that is the case—that it was not signed by Captain Wolvin until after the agreement had practically been made—I mean an understanding had been entered into between myself and Mr. Atwater.

X-Q. 231. Precisely. That is the fact, isn't it, that what you really did was to have an understanding with Mr. Atwater, and you and he acted on that understanding, and it was not until afterwards that any written paper was made by you at all; isn't that the fact?

A. As I remember it, it is.

MR. KREMER: Then you may explain.

MR. GARRISON: Wait a minute. The court will say whether he may explain or not.

MR. KREMER: Then I will ask the court if he may not explain.

THE COURT: Read the question and answer—I do not see that any explanation is needed. The answer is a full answer to the question. When you come to re-examine him you may bring out any circumstances that tend to break the force of that answer if you desire.

X-Q. 232. Now, Mr. Hyde, in confirmation of that fact, please refer to the book of exhibits that you have in your lap?

A. I haven't the book of exhibits with me; I think I left it in my room.

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X-Q. 233. Well, we will try and get you a copy. That is exhibit 166, page 82?

A. I have it.

X-Q. 234. You observe that that is a voucher receipted by you for your expense account for July, 1911, at five dollars a day, for 31 days, do you not?

A. I do.

X-Q. 235. So that it is quite obvious from that exhibit and from what you have now testified to that you were working under a verbal understanding with Mr. Atwater for many days before the date of any written contract; isn't that true?

A. It is true that it was before this written contract here, but I believe there was a written understanding between Mr. Atwater and myself, that he had received word from Captain Wolvin that he would sign at the proper time, or when the matter was submitted to him in final form, this agreement.

X-Q. 236. In other words, as I understand you now, you and Mr. Atwater reached an understanding; that was the first thing that was done, wasn't it?

A. He submitted—

X-Q. 237. Wait a minute; if I am wrong say no. Read the question.

A. We reached an understanding.

X-Q. 238. Then Mr. Atwater communicated with his principals, whoever they were; that is correct, isn't it, or he told you he had?

A. I believe he did.

X-Q. 239. And he told you that you and he would

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go ahead under your verbal understanding, isn't that correct?

A. I think that that is correct.

X-Q. 240. Now, when was that experimental machine, thus being fixed up, actually completed and work done on it?

A. I haven't a definite memory as to that matter.

X-Q. 241. Well, it was about the first of August, wasn't it?

A. My memory was that it was earlier than that.

X-Q. 242. At or about the first of August then?

A. At or about, yes.

X-Q. 243. And you made the runs on it, to demonstrate whether or not it would produce the results, did you not?

A. I did.

X-Q. 244. And those runs were successful enough to induce the company to go on with the rest of the understanding about the larger plant?

A. They were.

X-Q. 245. Now, under your contract, the sums of money that you received—this sum of \$5.00 a day, was to be paid you while engaged in mill work in said company's behalf; that is true, is it not?

A. Yes.

X-Q. 246. So that as long as we have vouchers showing \$5.00 a day paid to you, you were engaged in mill work in the company's behalf, were you not?

A. Well, I don't know what technical significance

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there would be in the statement in that way; I was working under the agreement as shown here.

X-Q. 247. You have had opportunity to, and I assume during the two or three weeks you have been here you have looked over these vouchers, have you not?

A. I have simply gone over them to see that they were vouchers for expenses.

X-Q. 248. Well, but you were informed that you were to go on the stand here and testify to your connection with respect to these matters, were you not?

A. I was.

X-Q. 249. And you had it back and forth between here and your lodging place, day in and day out?

A. I think it has been in my lodging place most of the time, yes.

X-Q. 250. So you have looked it over?

A. I have, yes.

X-Q. 251. So you knew, for the complete month of July, 1911, you received your \$5.00 a day, didn't you?

A. I received that expense money.

MR. GARRISON: Now, I ask to have everything stricken out after the word yes or no, as to that.

THE COURT: Well, it is another form of answering the question. Answer it more directly.

A. I did receive that amount.

X-Q. 252. Yes, and you received a similar amount for the month of August, 1911, for the full month, did you not?

A. I did.

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X-Q. 253. And for the full month of September, 1911, did you not?

A. As I remember it.

X-Q. 254. And up to the 26th of October, 1911, did you not?

A. I don't remember the exact date, but it was some such time.

X-Q. 255. Well, the vouchers will show. Don't let us have any doubt as to these things. It is on the voucher.

THE COURT: Any time you desire to refresh your memory from them, you may do so.

X-Q. 256. MR. GARRISON: If you will look on page 88, Exhibit 172, you will see the expense account for October, 1911, 26 days at \$5.00 a day, \$130.00. Now, if you want to look at the one for September, it is on page 86 and is exhibit 170. That is for 30 days of September, is it not?

A. Expense account at \$5.00 per day.

X-Q. 257. So that we find from these exhibits that you received your \$5.00 a day for July, August, September and 26 days of October? Is that correct?

A. That is correct.

X-Q. 258. And it was, I suppose on the 26th day of October, that you and Mr. Kremer left for Chicago, was it not?

A. I haven't any definite memory as to the date. It was about that time.

X-Q. 259. Now, did you ever receive any money from the Butte & Superior, leaving out these early ex-

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periments, those days that you received your actual expenses, not your \$5.00 a day, excepting moneys paid in accordance with the terms of the written contract?

A. I received the actual expenses of my traveling when ^{engaged} in the patent suit and in such visits as I made to the Butte plant after October 26th.

X-Q. 260. So that, with the exception of what you have just stated, the moneys that you received from the Butte & Superior Company were moneys that were paid to you under the terms of this written contract? Is that correct?

A. Or the supplemental agreement.

X-Q. 261. Or the supplemental agreement, yes; I should have included that. And all moneys paid to you under this contract excepting the \$5.00 a day were for your services?

A. The \$5.00 a day under the contract as well.

X-Q. 262. Read my question. I didn't say they were not.

(Question read.)

X-Q. 263. MR. GARRISON: And the \$5.00, if you wish?

A. And the \$5.00 a day.

X-Q. 264. And all the moneys that were paid to you including the \$5.00 a day were paid to you for your services? *Is that correct.*

A. Services and expenses.

X-Q. 265. And with respect to your patent, the number of which has been several times stated during your testimony, will you please give me the names of

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the other licensees in the United States outside of the Butte & Superior?

A. There are no other licensees at the present time.

X-Q. 266. Now, you have told us that you had a conversation with Captain Wolvin in October, 1911, in which you and he agreed on this matter of the expenses. Where was that conversation?

A. There were two conversations. The one which I referred to the other day, being the first of the two, was in the office of the Butte & Superior Comapny at the mine.

X-Q. 267. And in your direct testimony you stated that that conversation was had after you were sued for infringement? So it was some time after October 3d, 1911; is that correct?

A. Yes, sir.

X-Q. 268. And was that the first time that you and Captain Wolvin or you and anybody else on behalf of the Butte & Superior Company, had talked over the matter of the defense of any lawsuit to be brought against you?

A. I can't say that it was.

X-Q. 269. Search your memory and tell me whether it was or not.

A. I have no definite memory of any conversation with regard to the matter, but I doubt not that they occurred.

X-Q. 270. Do you doubt that they occurred before this?

A. They must have occurred before that. I don't

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remember the date upon which service was made upon me.

X-Q. 271. Well, the bill was filed on the 3d day of October, 1911. Now, then, you were not served until after the bill was filed, or on the same day, we will say, and so we will fix October 3d at the first day you could have been served. Now, did you have any conversation with Captain Wolvin about the payment of expenses of lawsuits prior to the 3d day of October, 1911?

A. I have no definite memory ^{with} regard to any. I saw Captain Wolvin very few times.

X-Q. 272. In your examination on Saturday you were asked whether you had not had conversation concerning the payment of expenses and taking charge, etc., of lawsuits against you, and you said that the first time that you had any such conversation was the one that you had with Captain Wolvin after the Hyde suit was brought. Now do you wish to correct that?

A. I have no definite memory in the matter whatsoever.

X-Q. 273. Have you any less definite memory today than you had on Saturday?

A. No. If I made the definite statement that I never had had such conversation I may have been in error.

X-Q. 274. Well, now tell us what this conversation was that you did have with Captain Wolvin in October of 1911 at the office of the Butte & Superior Company.

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A. The conversation was upon the date on which the supplemental agreement was entered into; and the main reason for the conference was the entering into that supplementary agreement.

X-Q. 275. Well, now, we will get that date immediately. That was the 26th day of October, 1911.

A. There is a record ~~of~~ⁱⁿ that agreement that a certain payment had been made to me that day, payment under the contract or under this modified contract, and, in the course of the conversation which took place between us I remember of asking Captain Wolvin: "Well, now, what are we going to do about the expenses of this lawsuit which has been brought against me personally?" And he made the reply that if I would agree not to compete with the company in acquiring or operating properties in the Butte district, and would give the company an exclusive license to the Butte district of any rights that I might acquire if I obtained a patent upon the process which I had developed and which I told them had certain novel features, that they would bear the expenses of the litigation.

X-Q. 276. Now, then, had you had any understanding or agreement with anybody on behalf of the Butte & Superior prior to that time concerning the payment **of** expenses of lawsuits brought against you?

A. As I said before, I have no definite memory of having had such.

X-Q. 277. In your examination on Saturday you stated that you had not had such conversation because

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it had not occurred to you that you would be sued or could be sued.

A. I was mistaken in that statement and my memory—as I have thought the matter over I remember that there was a definite statement made to me that I probably would be sued.

X-Q. 278. And when was that definite statement made to you that you probably would be sued?

A. I don't remember whether that statement was made by Mr. Nutter or Mr. Spitzer. Both of them had been here in Butte and had conversation with me on the matter. It would be preceding—it would be preceding the actual filing of the suit.

X-Q. 279. And you stated in ^{some corrections} ~~cross examination~~ that you made this morning that you had been to see Mr. Kremer before August 18, 1911; is that correct?

A. That is correct.

X-Q. 280. How did you get that date of August 18, 1911?

A. I asked Mr. Kremer this morning and he said that he remembered that it was previous to that date.

X-Q. 281. He showed you a letter, didn't he?

A. He did.

X-Q. 282. Showed you a letter from Mr. Williams, didn't he?

A. He did.

X-Q. 283. So that it was known by Mr. Kremer as early as August 18 that you were to be sued, and he wrote to Mr. Williams that he was the attorney engaged to defend you, did he not?

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A. He did.

X-Q. 284. So that, as a matter of fact you had gone and retained Mr. Kremer's services as early as August 18, 1911?

A. That is why I corrected my answer with regard to the date, this morning.

X-Q. 285. And you did not correct that answer until Mr. Kremer had shown you correspondence between Mr. Williams and himself, did he?

A. Because I had no memory of its being at so early a date.

X-Q. 286. But you had a very distinct memory that you had not gone to see Mr. Kremer until after you were sued, did you not?

A. I did.

X-Q. 287. And that you had a very clear picture in your mind which you conveyed to us of walking into his office and telling him you had been sued and asking him whether he was in a position to defend you, as if it was the sole case in his office, and all of that you told us, did you not?

A. All of this was true of the occasion when I did go to see him and retained him.

X-Q. 288. Yes, but you recited this conversation with dramatic certainty, after you were sued, did you not, you stated that you went down there after you were sued. You were mistaken about that, were you?

THE COURT: You are qualifying the witness.

MR. GARRISON: I will withdraw that question. I think it is objectionable.

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X-Q. 289. You had a very clear memory on Saturday of going down to Mr. Kremer's office after you had been sued and having this conversation about his qualifications to take your case; isn't that correct?

A. That is exactly the way in which I remembered it.

X-Q. 290. Now, what was the occasion of your going and engaging Mr. Kremer's services in August, 1911?

A. I don't remember definitely, but I take it for granted that it was the result of having been informed that I would be liable to be sued.

X-Q. 291. At that time you expected to have to bear all the expense of that suit, didn't you?

A. I have no memory as to what I expected at that time.

X-Q. 292. You had a very clear memory on Saturday that up until the service of papers in the suit, it had never occurred to you that you would be sued, and therefore that was the first time you made any arrangements about the expenses of such a suit.

A. I corrected the record this morning, because I found that my memory was not correct on Saturday.

X-Q. 293. When you went to see Mr. Kremer did you ask him what his retaining fee would be?

A. I don't remember of having arranged the matter of the fee.

X-Q. 294. Did you pay him any money?

A. I did not.

X-Q. 295. Well, what did you do with Mr. Kremer

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at that time; did you give him the patents of Minerals Separation on which they would be liable to base their suit?

A. I don't know that I gave them to him at that time, but I am very certain that I gave him a record of such patents relating to the whole subject as I had been able to ascertain.

X-Q. 296. At or about that time?

A. At or about that time.

X-Q. 297. Now, previous to this, and when you were in New York, you had gone into this patent situation with Mr. Stone of Hayden, Stone & Company, hadn't you?

A. No, I never met Mr.—

MR. KREMER: I object to that as incompetent, irrelevant and immaterial for any purpose and no connection with this suit whatever.

THE COURT: It is cross examination.

MR. KREMER: The record shows that at that time Hayden, Stone & Company had nothing whatever to do with the company.

THE COURT: I think he may inquire. Objection overruled.

Defendant excepted.

A. I met no member of the firm of Hayden, Stone & Company when I was in New York before coming to Butte.

X-Q. 298. Had you ever gone over this patent situation before you went over it with Mr. Kremer?

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A. Why, I had gone over it in my personal study of the matter. I don't know whether I had with anybody else.

X-Q. 299. Had you seen any attorneys about it?

A. No, I had not.

X-Q. 300. Didn't you tell Mr. Nutter that you had seen an attorney about it.

A. I have no memory of telling Mr. Nutter that I had. It is—

X-Q. 301. Go on and make your explanation?

A. I went over the whole details of this thing when I was in London, and as Mr. Herbert Hoover testified in the Hyde case—

MR. GARRISON: This is certainly not in response.

THE COURT: Read the question.

(Question read.)

THE COURT: Answer that question.

A. I don't remember ever having told him so.

X-Q. 302. Now, then, after you had gone and engaged Mr. Kremer's services in August of 1911, you did go over the patent phase of the matter with him, didn't you?

A. I did.

X-Q. 303. And he referred the matter to Sheridan, Scott, Wilkinson & Richmond, or whatever the name of the firm was at that time?

A. I think that is correct.

X-Q. 304. And he informed you that he had done so, did he not?

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A. I presume that he did.

X-Q. 305. And you wrote Mr. Clark the letter which I showed you the other day, in which you conveyed that information to Mr. Clark?

A. I did.

X-Q. 306. Then you were entirely wrong in your testimony on Saturday concerning that matter?

A. I was.

X-Q. 307. Now, you knew that a suit of this character would cost a very great deal of money, didn't you?

A. I knew nothing about what the cost would be, but I expected it would be great.

X-Q. 308. What is that?

A. I had no definite knowledge of what such costs might be, but I expected they would be large.

X-Q. 309. Your own guess was that it would be more than thirty thousand dollars, wasn't it?

A. I took it for granted that it would be.

X-Q. 310. More than thirty thousand dollars?

A. Yes.

X-Q. 311. Now, did you have any thirty thousand dollars to spend in a lawsuit to get the privilege to the Butte & Superior Mining Company to operate without payment of royalty to Minerals Separation?

A. I did not.

X-Q. 312. And in your view—your expressed view—it was utterly unreasonable to expect you to do that, to defend this suit, in order to get them that privilege; isn't that correct?

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A. If I had not been able to make the arrangements with them, I would have had to retire from the field.

X-Q. 313. Answer the question please.

(Last question read.)

A. It was.

X-Q. 314. Now, then, at the time that you had entered into arrangements with them in June or July, whenever it was, you talked over this whole question of suits on behalf of Minerals Separation to obtain injunctions to prevent the use of their process, didn't you?

A. I have no definite memory as to what the conversation went into but I know that the matter was discussed.

X-Q. 315. Now, let me help your memory. In exhibit No. 8, page 38 of the book of exhibits, that being a letter from you to Mr. MacKelvie, dated July 13th, 1913, you wrote as follows: "The fact that a patent suit would result from proceeding to use the flotation process was known to all concerned, and the three attorneys upon the old board of directors should have been able to anticipate what the suit would amount to in the way of costs. Our relations were in no way modified by the fact that suit was brought in my name. Its object is to enjoin your company from the use of the process and to compel it to pay a royalty, and is brought against me solely for the performance of acts carried on for your company." Now, all that, you say, was known at the time that you began talking

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to these people about selling them whatever information you had concerning flotation processes, wasn't it?

A. It was understood that there would probably be a suit.

X-Q. 316. And it was understood that the company should pay the expenses of that suit, wasn't it?

A. I don't remember the definite—I mean the absolute definite nature of the understanding in the matter.

X-Q. 317. Well, you are drawing some fine line of distinction, aren't you, between whether a thing was stated in certain language or stated in certain other language, isn't that right?

A. No, I am stating the actual ^{condition}~~situation~~ of my memory, that I don't remember the details.

X-Q. 318. I don't ask you for details; I ask you whether, in view of what you have testified here and written here, there was not an understanding—without regard to the express language of that understanding—that if a lawsuit was brought by Minerals Separation Company to prevent the carrying on of this operation at the Butte & Superior mill, that they would have to bear the brunt of that suit; wasn't that your understanding?

A. As expressed in this letter, it is.

X-Q. 319. No, but as your understanding at the time; was that your understanding after you had these conversations with these gentlemen?

A. I don't see that I can add anything to my previous answers.

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X-Q. 320. It is because I don't understand you. In this letter of July 13th, 1913, as I understand you now, you were conveying to Mr. MacKelvie what the understanding was at the time you entered into this arrangement, weren't you; isn't that correct?

A. That is what I understood, that they ^{realized} ~~realized~~ what the circumstances would bring forth.

X-Q. 321. Exactly; that if a suit was brought that they would have to stand for that suit?

A. I don't remember of there being any definite understanding as to what would happen if a suit were brought against me personally.

X-Q. 322. But the situation was this, wasn't it, that you all knew that a suit would be brought to try to prevent the Butte & Superior Mining Company operating a flotation process claimed to be an infringement of the M. S.?

A. We all knew that there were threats that that would be done.

X-Q. 323. And the understanding that you had was that if that was done the company would have to take charge of any such suit; that you were not going to stand the expenses of such suit?

A. I think they understood that I could not stand the expenses.

X-Q. 324. And it was understood that they would; isn't that correct?

A. I don't remember how far the agreement went as to what they would stand or would not stand, because there was no agreement between the company

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and myself at any time that they would fight a suit rather than pay royalty.

X-Q. 325. But if they elected to fight a suit they were to stand the brunt of that, weren't they?

A. Certainly.

RE-DIRECT EXAMINATION,
BY MR. KREMER:

R-Q. 326. Mr. Hyde, referring to the exhibit that Judge Garrison just interrogated you with reference to, wherein you referred to a suit, I will ask you if it is not a fact that you had heard previous to August, 1911, that suit would be brought against the Butte & Superior, and state from whom you heard those threats?

A. I heard those threats from E. H. Nutter, and from a Mr. Spitzer, who, I understood, was connected with the firm of Beer, Sondheimer & Company.

R-Q. 327. Did you ever have an understanding prior to that understanding that you have referred to in your testimony as having been made with reference to the defense of the so-called Hyde Suit—did you ever have an understanding with the Butte & Superior that they would defend the suit if you were sued?

MR. GARRISON: I object to the form of the question.

THE COURT: Yes.

(Question withdrawn)

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R-Q. 328. MR. KREMER: Did you ever have an understanding with the Butte & Superior company that they would defend a suit brought against you, prior to the understanding that you have testified that you had with Captain Wolvin?

MR. GARRISON: I object to the form of that question.

THE COURT: Objection sustained.

Defendant excepted.

R-Q. 329. Did you ever have any other understanding with the Butte & Superior with reference to the defense of a so-called suit, than the one you have testified to?

MR. GARRISON: I object to that, if your honor please.

THE COURT: Objection overruled.

Plaintiff excepted.

A. I have no memory of any agreement of that sort.

R-Q. 330. In answer to a question propounded by Judge Garrison you stated that you thought that the expense of defending this suit brought against you, or a suit that ^{might} be brought, would exceed \$30,000. Will you explain why you thought so, if you can, or how much more than \$30,000 you thought it would cost.

A. I had no definite basis upon which to judge as to what the cost of ^{such} a suit would be. I had known of certain patent litigation going on, where expert witnesses had been retained, and so forth, and knew that the expenses were very large.

James Macdonald Hyde.

R-Q. 331. Did the expense of that suit have anything to do with the figure mentioned in your contract with the Butte & Superior?

A. As stated in one of Mr. MacKelvie's letters—

R-Q. 332. No, just answer the question, Mr. Hyde.

A. It did not.

(WITNESS EXCUSED).

MR. KREMER: We desire, at this time, if your honor pleases, to offer a certificate from the acting commissioner of patents, accompanying a disclaimer or purported disclaimer, to the effect that no other disclaimer had been filed in the patent office of the United States, save and except the one thereto attached.

Paper admitted in evidence without objection and marked DEFENDANT'S EXHIBIT.

THE COURT: Is it the same disclaimer referred to?

MR. KREMER: Yes, sir.

THE COURT: It is utterly useless.

MR. KREMER: The question is of a negative character, that a search has been made.

MR. WILLIAMS: We will stipulate that no other disclaimer has gone in.

THE COURT: Well, it may go in. When the record is made up a great deal of this will be cut down.

Certificate admitted in evidence and marked DEFENDANT'S EXHIBIT No. 234.

J. T. Shimmin.

J. T. SHIMMIN, Recalled, testified as follows:

DIRECT EXAMINATION

BY MR. SCOTT:

Q. 1. You have produced papers entitled "Butte & Superior Mining Company", one dated April 28th, and one dated April 29th and one dated April 30th. Are the operations recorded in these reports those which were carried on under your supervision?

A. Yes.

Q. 2. And to the best of your knowledge and belief they correctly represent the results of those operations and conditions under which they were conducted?

A. Yes.

MR. SCOTT: I offer the papers in evidence, the same being the records of the Butte & Superior Mining Company of mill operations on April 28th, 29th and 30th, and we offer them as one exhibit.

Papers admitted in evidence and marked
DEFENDANT'S EXHIBIT 235.

CROSS EXAMINATION

BY MR. WILLIAMS:

X-Q. 3. These are the official reports from the records of the company of the proceedings of those three days, is that correct?

A. Yes.

X-Q. 4. On April 30th, the day that we were there, where did you put the oil in?

J. T. Shimmin.

A. I think at the discharge of the tube mill; I am not certain.

X-Q. 5. You don't know?

A. I am not positive, no.

X-Q. 6. On April 28th, the day before we were there, where did you put the oil in?

A. The feed end of the tube mill.

X-Q. 7. It was changed the morning we were there from the feed end of the tube mill to the discharge end of the tube mill?

A. Yes.

X-Q. 8. What are you doing now; feed end or discharge end?

A. Well, in fact I don't know; I think it is going to the feed end.

X-Q. 9. You have been doing that for a considerable time, have you not, putting the oil in at the feed end of the mill?

A. Yes, we have.

X-Q. 10. What kind of tube mills are those which you have?

A. They are the regular—well, they are four and a half by twenty, Denver Engineering Works.

X-Q. 11. Cylindrical?

A. Cylindrical mills, yes.

X-Q. 12. Are they pebble mills or ball mills?

A. The first 16 feet is pebble, and the balance is balls.

X-Q. 13. In the same tube?

A. In the same tube, yes.

J. T. Shimmin.

X-Q. 14. The balls are of what material?

A. Manganoid.

X-Q. 15. Is that a manganese steel?

A. No, it is called manganoid; it is a ball made by the Jeffrey Manufacturing Company.

X-Q. 16. About what is its composition?

A. I couldn't say offhand.

X-Q. 17. It is manganese and iron?

A. I think it is.

X-Q. 18. The name manganoid is just a trade name, isn't it?

A. Just a trade name.

(WITNESS EXCUSED)

MR. SCOTT: That closes our case.

MR. WILLIAMS: There were some particulars that Mr. Dosenbach was to furnish. Hasn't he got them? He was to give an assay of the sulphide ore.

MR. SCOTT: We will ask the court if these assays may not be put in without delaying the matter any further. He didn't have them Saturday.

MR. WILLIAMS: Have you got them, Mr. Dosenbach?

MR. DOSENBACH: I have an assay of the copper sulphate. I haven't an assay of the molybdenite.

Ben H. Dosenbach.

BEN H. DOSENBACH. Recalled for further direct examination.

BY MR. SCOTT:

Q. 1. You may state, Mr. Dosenbach, what the assay of the molybdenite ore was that you used in your experiments here in court.

A. I haven't got the correct assay yet but it is approximately what I gave before; won't vary within several tenths of a percent.

Q. 2. Excuse me, I got the wrong one. Well, the sulphate?

A. I have an analysis of the copper sulphate as far as I have it, it is about 1.58% copper; about .3 silver; 3.68 sulphuric acid; 5.79 sodium chloride or salt. I haven't a determination of the iron or the ferric or ferrous salts. This is under the general determination that we make up there, and this is one analysis that I happen to have.

MR. WILLIAMS: That is all.

MR. SCOTT: As to the assays of the samples that were taken from these experiments I take it that you agree that they may go in evidence as soon as we have them?

MR. WILLIAMS: Yes, but Mr. Thomas Janney has not yet been excused as a witness, and I understood from him yesterday that he had to go home because of illness and that he would leave with you certain information which I had asked him for. Have you that?

Ben H. Dosenbach.

MR. SCOTT: I didn't see him yesterday.

MR. DOSENBACH: As I understand, you requested for the days the shifts, upon which certain experiments were run and he left that with me so that I can now give it to you.

MR. WILLIAMS: Well, if you will read it in the record, that will be acceptable.

MR. DOSENBACH: The experiment No. 14 was run on the day shift of April 6th, 1917; experiment No. 15 was run on the third shift or the graveyard shift, April 5, 1917; experiment No. 16 was run on the second shift of April 5th, 1917; experiment 28 was run on the third shift of April 8th for the first 4 hours; experiment No. 29 was run on the third shift of April 8th for the second four hours.

MR. WILLIAMS: Experiment 30. Have you got that?

MR. DOSENBACH: That is all he gave me. No, I didn't get any for that, 14, 15, 16, 28 and 29 is the information that he gave me.

MR. WILLIAMS: Now, Mr. Scott, there was an exhibition to our representative of operations of one of the Utah plants and we took specimens and the Utah representatives took specimens. I intended to ask Mr. Tom Janney for the particulars of that day's run. Can you supply us with the actual reports or any particulars?

MR. SCOTT: No, I don't think I have the report. I can probably get it by writing, if you will accept it in that form.

Ben H. Dosenbach.

MR. WILLIAMS: I will accept Mr. Janney's statements. I will take Mr. Thomas Janney's statements as the equivalent of evidence.

MR. SHERIDAN: Mr. Frank Janney was there.

MR. WILLIAMS: You are right about that—Mr. Frank Janney.

MR. SHERIDAN: Well, we will wire down to Mr. Frank Janney and get the data.

(WITNESS EXCUSED).

MR. WILLIAMS: Now, your honor, I would like to have a rather distinct understanding as to the testimony of Prof. Taggart in relation to certain tests, followed by some testimony of Frank C. Janney. The ruling of the court was that that testimony be stricken out. The testimony was, of course, written at length by the stenographers in the record. It is my understanding that your honor ordered it to be bodily stricken from the record.

THE COURT: What is that?

MR. WILLIAMS: The experiments made by Prof. Taggart, which your honor struck out as hearsay, on May 2nd, and it appears in the record commencing—Well, I have the details of it—It was an experiment as to which the witness was wholly unable to testify and your honor struck it out as hearsay. Now it is in the stenographic minutes. I would like to know whether your honor wishes it excluded from the record. The defendant reserved a right to make some sort of a statement. Unless, then, the

testimony goes out, and the defendants make some sort of a statement, that is my understanding of the way the record is to be made up. Of course, as a matter of fact, I stopped cross examination when your honor ordered the testimony stricken out.

MR. KREMER: My understanding, if your honor please, was that your honor ordered it stricken out and we simply excepted. Then it remains in the record. That is, it is represented in the record, but not in the record for consideration by counsel to such a degree that it calls upon him to cross examine upon it. To all intents and purposes the testimony has been rejected.

THE COURT: I can not see any difference in principles whether it is excluded altogether from the record or left in. There might be, if there was an exception taken. Did you take an exception?

MR. KREMER: There was an exception taken. It merely becomes a part of the record.

THE COURT: When it was ordered stricken, did the defendants take an exception?

MR. KREMER: Yes, your honor.

THE COURT: I think it ought to remain in the record so that if it ever goes to the Appellate Court, if this should have to go up, they would have the benefit of their exception. Otherwise, if we struck it out altogether, the Appellate Court could not say whether it was properly stricken or not. It should remain in in order that they will have the benefit of it. If it remains in the record it would not be

P. 4025, L. 1, insert "considered' by this Court, and certainly it would not be "

considered by the Appellate Court more than to consider the question. Of course, since you have not cross examined upon it, it would not determine the question, if it was of sufficient importance to take a note on it. That is the practice here.

MR. GARRISON: Have you closed now, with this exception?

MR. KREMER: We close.

MR. GARRISON: Now, we move to strike out all testimony offered in behalf of the defendant to which we objected on the ground that it was irrelevant and immaterial and incompetent because it did not represent anything in the prior art and did not therefore meet any issue that was raised in this case, and which was admitted by the court upon the promise of the counsel for the defendant that they would connect the testimony with the prior art and therefore make is competent. The motion that I am now making is based upon their failure to make such connection and to show the relevancy and materiality and competency of such testimony by showing that it did represent the prior art, or any part thereof.

THE COURT: Well, to all intents and purposes you are moving to strike out all their testimony?

MR. GARRISON: Of that character.

THE COURT: There is some of it, undoubtedly the court will not take into consideration as not representing the prior art. I do not think the court can grant a motion made in that way. I think we are bound to leave all of this testimony in, and when

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we come to make up our decision, as far as it is entitled to weight the court will give it weight, and as far as it is not, the court will not consider it. Of course it will leave the case in such shape that you can for your safety meet any or all of it that you may see fit. The motion will be denied.

MR. GARRISON: Exception.

MR. WILLIAMS: On behalf of the plaintiff, the rebuttal testimony will be opened by evidence of the acquiescence in the patent in suit and of the great utility of the invention, the extensive use that has been made of it, not with any effort to make a complete showing, but to make a sufficient showing as to these facts, and I will first call Mr. Ballott to the stand.

WHEREUPON THE FOLLOWING TESTIMONY
WAS OFFERED IN REBUTTAL:

JOHN BALLOT, recalled in rebuttal, testified as follows:

DIRECT EXAMINATION,
BY MR. WILLIAMS:

Q. 1. I wish you would give a list of the licensees in America of Minerals Separation Limited, and Minerals Separation, North American corporation.

MR. KREMER: To which we object for the reason

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that it is incompetent, irrelevant and immaterial and does not tend to prove the charge of infringement.

THE COURT: The objection will be overruled.

MR. KREMER: Exception. And your honor will permit me to add a further objection which I understand Mr. Williams will meet. In connection with these licensees I understand that you are going to produce the licenses?

MR. WILLIAMS: Well, I believe all of the licenses are here. It may be that one or two of the later licenses, which will be in form exactly the same as the others, may not be here.

MR. KREMER: Can you tell us the substance of them?

MR. WILLIAMS: I think we can supply the information that the defendant may want as to the details of these licenses and we have the originals here with will be proffered insofar as necessary, although we hope not to make too large a record in the matter.

MR. KREMER: I will state, to save this time, we assume that some time during the case that these licenses will represent a matter that should have the scrutiny and inspection of the defense, but both for the purpose of showing the so called acquiescence that they claim, and if perchance it should ever become necessary to look to the licenses to see the course and condition of business, they will be available.

MR. WILLIAMS: We will be very much pleased to show how reasonable we are with our licensees.

John Ballot.

Q. 2. Read the list now.

A. "Inspiration Consolidated Copper Company; M. W. Atwater, Consolidated Arizona Smelting Company. Wm. B. McDonald and Louis S. Noble, Atlas Mining & Milling Co., The Elm Orlu Mining Co., Old Dominion Mining and Smelting Co., Weedon Mining Company, Mountain Copper Company, Limited, Engels Copper Mining Company, St. Joseph Lead Company, Anaconda Copper Mining Company, Cananea Consolidated Copper Company, Arizona Copper Company, Limited, Arizona Copper Company, of Arizona, Doe Run Lead Company, Desloge Consolidated Lead Company, Utah Leasing Company, Napoleon Mining Company, Chichagoff Mining Company, Colusa Parrot Mining & Smelting Company, Dutch Sweeney Mining Company, Portland Gold Mining Company, Stoddard Milling Company, Butte Central Mining & Milling Company, Goldfield Consolidated Mines Company, Reward Gold Mining Company, Ely Associated Brockman & Company, Ceylon Company. Ducktown Sulphur, Copper & Iron Company, Phelps Dodge & Company, Pigrey Mines, Vindicator Consolidated Gold Mining Company, Broadwater Mills Company, Britannia Mining & Smelting Company, Mond Nickel Company, Limited, Cuba Copper Company, Silverton Mines, Flint Mines, Limited, Mineral Recovery Company, Standard Silver Lead Mining Co., Cusi Mining Company, Highland Valley Mining & Development Co.; and in South America, Braden Mines in Chili.

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MR. WILLIAMS: I regret to find that my very valuable assistant has not brought the original licenses into court at the present moment but they will be produced later.

MR. KREMER: That is all right.

MR. WILLIAMS: I now produce an affidavit by Henry Falck, the general office manager for Beer, Sondheimer & Company, Inc., the American agents for Minerals Separation Limited, plaintiff. It has been stipulated between counsel that this affidavit shall be received in evidence with the same force and effect as though Mr. Falck were brought here from New York and testified as to the facts stated in the affidavit; and a table of returns and payments of royalties by United States licensees of Minerals Separation Limited, which is annexed to the affidavit.

MR. KREMER: This stipulation, Mr. Williams, is, of course, subject to the objection that it is incompetent irrelevant and immaterial for any purpose in the case. We do not object to the fact that Mr. Falck is not present.

THE COURT: It is not incompetent, that is, as to form.

MR. KREMER: Not as to form. Our stipulation goes to the matter of form. Incompetent as to the matter of substance. It makes the trip of a man from New York unnecessary.

THE COURT: The objection will be overruled.

MR. KREMER: Exception.

John Ballot.

MR. WILLIAMS: The affidavit and annexed table are offered in evidence.

MR. KREMER: The defendant objects for the reason that as to substance the affidavit and the exhibits there attached is incompetent, irrelevant and immaterial for any purpose in the case.

THE COURT: As far as the receipts are concerned I doubt if it would be of very much materiality, but it will be allowed to be introduced over the objection. The objection will be overruled.

MR. KREMER: Exception.

Whereupon affidavit was admitted in evidence
MARKED PLAINTIFF'S EXHIBIT 236.

Q. 3. MR. WILLIAMS: I show you the table of returns and payments of royalty annexed to Mr. Falck's affidavit and call your attention to the fact that in the column, "Tonnage Material Treated" there are several items marked "Not reported." Will you explain why these items are not reported, or were not reported?

A. The tonnage of ore treated, because this was to be paid in percentages on metals recovered.

Q. 4. And on the other hand, in the column headed, "Tonnage of concentrates Recovered" there are several items marked "Not reported." Why are those items not reported?

A. Why, they paid on the tonnage of straight ore treated. We were not concerned with the concentrates.

John Ballot.

Q. 5. That is to say, as I understand it, if the license provided that royalty should be paid upon the ore treated, then the return shows the tonnage of ore treated?

A. Yes, sir.

Q. 6. And if the license provides that the payments shall be made upon concentrates recovered, then the returns show the concentrates recovered?

A. That is correct.

Q. 7. So that the table does not give entirely the total of ore treated by the licensees or the total of concentrates recovered by the licensees?

A. That is correct.

Q. 8. The only total given in the table is under the heading of amount, which of course is the royalties, and there the amount is \$1,155,258.24. That is the total royalties received is it not?

A. That is correct.

Q. 9. From the licensees in the United States of America?

A. In the United States of America.

Q. 10. And as to the other licensees in America, whose names you have given, those in Canada, Cuba and South America, there is no reference whatsoever to their payments in this table?

A. That is correct.

John Ballot.

CROSS EXAMINATION,

BY MR. SCOTT:

X-Q. 11. Mr. Ballot, are these sums paid to Minerals Separation as shown in the list you exhibited, paid exclusively for the right to operate under the patent here involved in this suit, No. 835120, or are there other patents?

A. There are other patents. All the licensees are entitled to use all or any patent.

X-Q. 12. And some twenty or more other patents, are there not?

A. More than twenty.

X-Q. 13. Among those patents is there included what is generally referred to as the Potter patent, and a Delprat patent?

A. In some of them; not all.

X-Q. 14. Are these processes described in the Potter patent and the Delprat patent being used?

A. I don't know; I haven't heard of it.

X-Q. 15. Have they ever been used?

A. By American licensees?

X-Q. 16. Yes.

A. Not that I know of.

X-Q. 17. By anyone?

A. Not that I know of.

MR. WILLIAMS: I object to the inquiry which is intended to cover the whole breadth of the earth, as I understand it, as indefinite.

John Ballot.

THE COURT: He has answered it.

X-Q. 18. MR. SCOTT: You mean to state distinctly that you do not know that anyone anywhere ever made use of the Potter process and the Delprat process?

MR. WILLIAMS: I object to any inquiry of this character as wholly irrelevant and immaterial and not within the scope of the direct examination of the witness; wholly immaterial and irrelevant.

MR. SCOTT: The alleged evidence of acquiescence has included reference to companies outside of the United States, Canada and Chili, and it is my purpose to develop to what extent these licensees have any connection with the patent here in suit and to what extent they may be paying for others of the privileges granted for these licenses herein, and it seems to be entirely proper, when we have figures brought here representing payments of money calculated, or at least deemed by the plaintiff to show the alleged importance of its patents—

THE COURT: Well, do we understand that applies also on the Delprat and Potter?

MR. SCOTT: I think Mr. Ballot said they were included in these lessee agreements.

THE WITNESS: Some of them.

MR. SCOTT: And I think it is my purpose to show that these have been used exclusively, have never been supplemented in some localities, and there is no reason to infer that these figures which have been presented before the court are due entirely, or are due

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in a large degree to the particular patent that is now before the court.

MR. WILLIAMS: These facts are limited to the United States.

THE COURT: The facts are such that there is other testimony, covering other countries. I think it is proper cross examination. He may answer. Objection overruled.

Exception by plaintiff.

THE COURT: It will be noted.

X-Q. 19. (Question read as follows) "Q. You mean to state distinctly that you do not know that anyone, anywhere ever made use of the Potter process and the Delprat process?"

THE COURT: I think I will limit it to their licensees. You asked him "anyone". You may change the question. So far as the question is objected to in that form, the court will sustain the objection. It should be limited to the licensees.

X-Q. 20. MR. SCOTT: Do you mean to state distinctly that none of the licensees of Minerals Separation, Limited, have ever made use of the Potter process or the Delprat process?

A. I never heard of that. I don't know.

X-Q. 21. Has Minerals Separation, Limited, licensees, either directly or indirectly through subordinate companies, in countries other than the United States?

A. Through subsidiary companies.

X-Q. 22. And in what countries does Minerals

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Separation Limited grant licenses through subsidiary corporations?

A. Minerals Separation has only granted licenses in America, including United States, Canada, Mexico and Cuba.

X-Q. 23. Minerals Separation, Limited, has no connections in Australia?

A. Indirectly as shareholders in a company owning the processes there.

X-Q. 24. And either directly or indirectly has Minerals Separation, Limited, any licensees in Australia?

A. Directly, yes; indirectly, no. Directly, yes, licenses were issued while Australia belonged to Minerals Separation. These licenses have simply remained in the same name and passed, after transfer, over to the purchasing company when they acquired the Australian rights. And no, since then we have no direct connection.

X-Q. 25. And who were these licensees; who are licensees direct from Minerals Separation Limited?

A. In Australia?

X-Q. 26. In Australia.

A. Before the—

X-Q. 27. Before the arrangement you just spoke of.

A. The Sulphide Corporation, the Zinc Corporation,—some minor companies I don't recall.

X-Q. 28. Did either the Sulphide Corporation or the Zinc Corporation ever use the Potter process or the Delprat process?

A. Not that I know of.

John Ballot.

X-Q. 29. Now, what is the arrangement at present for the granting of licenses in Australia?

A. The Australian company grants them directly.

X-Q. 30. And do any of the licensees of the Australian company use the Potter process or the Delprat?

A. Not that I know of.

X-Q. 31. What is the extent of your information about what these licensees are doing?

A. I have no direct information.

X-Q. 32. You are in a state of complete ignorance as to what these licensees are doing after they get their licenses?

A. We don't bother our licensees.

X-Q. 33. Do you know what these licensees in the United States are doing; what processes they are practising, whether it is one or the other of these 20 or 30 processes that you grant the licenses under?

A. I have a general idea; I can't say that I have definite information.

X-Q. 34. Might be the Kirby process for all you know, or the Froment process or the Glogner process or any of these prior art processes for all you know; is that the idea?

MR. WILLIAMS: Why, if your honor please, there has not been a word of proof that these things that are described in these patents were processes of the prior art, and they are put to this witness as though they had some tangible existence, other than on sheets of paper. I object to the form of the question.

John Ballot.

(Question read as follows: "Q. Might be the Kirby process for all you know, or the Froment process or the Glogner process or any of these prior art processes for all you know; is that the idea?")

THE COURT: What is your objection?

MR. WILLIAMS: My objection is that the thing that the defendant calls "processes" are things that exist only on pieces of paper. They have no definite standing in the art of concentrating ores; and to present them to the witness as processes of the art is to misrepresent the evidence that the defendant has brought to this court.

MR. SCOTT: Some of these patents I have mentioned are the ones you grant licenses under. You include them in your definition of prior art.

MR. WILLIAMS: Some of them are mere paper patents.

THE COURT: The difficulty is that I think the witness has answered that their licensees, or these licensees are entitled to use all such patents, some 20 or more. Now, he is trying to weed out and find how many of these are operating under the patent in suit, which of course is all that is material here, and how many of these licensees may be operating under some other patent.

MR. WILLIAMS: Yes, but the statement he has put in his question, the patents he has referred to are not patents that are in the list.

THE COURT: There is the difficulty. The court does not know.

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MR. WILLIAMS: We haven't the schedule here.

THE COURT: The court does not know. It is for you to show. Unless these are patents that are a part of the licenses, it is immaterial.

MR. SCOTT: He has not produced it and I can not tell which are, but I will withdraw the question to avoid the difficulty.

X-Q. 35. Now, Mr. Ballot, you claim to have no knowledge of what processes your licensees or your licensees through subsidiaries are practicing in Australia. Have you any definite knowledge of what they are practicing in this country?

A. I have no personal knowledge of what they use.

X-Q. 36. When did Phelps, Dodge & Company become a licensee of Minerals Separation; about what was the date when they became licensees?

A. That is a matter of memory; I think it was 1913.

MR. WILLIAMS: May I help the witness.

MR. SCOTT: You can give the date.

MR. WILLIAMS: The date of that license as given by a list prepared is June 11th, 1914.

THE WITNESS: 1914, I believe that is correct.

X-Q. 37. I think, Mr. Ballot, that the name Phelps, Dodge & Company does not appear in the list of royalty payments which you produced; is that correct?

A. I believe that is correct.

X-Q. 38. And can you explain why that is?

A. Because they have not paid.

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X-Q. 39. Have they milled any ore under any one of these twenty or thirty patents that they had the license under?

A. I don't know from personal knowledge; they have not made a return.

X-Q. 40. How do you proceed to find out whether these licensees owe you any money or not, if you don't know whether they are practicing one of your twenty or thirty processes, or not?

A. The licensees are asked every quarter to make returns.

X-Q. 41. Did you ask—do you ask Phelps, Dodge & Company, for a return?

A. Possibly; I cannot tell you from personal knowledge. It is an office routine; I cannot tell you.

X-Q. 42. Do you know any reason why they have not made any payments to you?

A. No.

X-Q. 43. Have you ever tried to find out why that is?

A. I expect the office has found out.

X-Q. 44. Well, does their license provide that they—how does it provide that they shall pay you any money?

A. Well, if they are honest people they ought to send in returns quarterly when they treat.

X-Q. 45. Were you ever in Australia?

A. No, sir.

X-Q. 46. Are there any others of these licensees upon that list who have never paid you any license fees?

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A. I find the Old Dominion Mining & Smelting Company, yes.

X-Q. 47. Have you named all those that have made no payments?

A. I recognize the Old Dominion Mining & Smelting Company.

X-Q. 48. Any others?

A. There are some, but I cannot answer in person.

X-Q. 49. Is it not true that none of these people have made any payments, except those whose names appear on the statement accompanying Mr. Falk's affidavit?

A. The licensees in the United States—possibly.

X-Q. 50. Well, in the United States has any company or individual paid license fees other than those upon the list accompanying Mr. Falck's affidavit?

A. I don't think so.

X-Q. 51. How many licenses did Minerals Separation, Limited, have in the United States, in October, 1911?

A. I couldn't tell you that from memory.

X-Q. 52. You know they didn't have any, don't you?

A. October, 1911?

X-Q. 53. October, 1911?

A. Possibly not; possibly not.

X-Q. 54. What is your position in Minerals Separation, Limited?

A. Chairman and managing director.

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X-Q. 55. Don't you, as chairman and managing director, know whether or not Minerals Separation, Limited, had a licensee in the United States in October, 1911?

A. I do.

X-Q. 56. And they did not have any, did they?

A. Possibly not. I could verify it, but from memory I cannot.

X-Q. 57. Well, I wish you would verify it. Isn't it a fact that the first license that was ever granted by Minerals Separation Company to anyone in the United States was that to the Inspiration Copper Company on April 10th, 1913?

A. It is one of the earliest, if not the earliest.

X-Q. 58. Can you state positively whether it is the earliest or not by referring to this paper from which you refreshed your memory?

A. If this list represents the full list of licensees, it is the first; it is the first on the list.

X-Q. 59. Do these reports which you get from these licensees show anything about what kind of a process they are operating, whether it is one or the other of these many patents?

A. No.

X-Q. 60. Who has all this information about what these licensees are doing?

A. I expect they have their own reports—their own records. We don't keep them.

X-Q. 61. No one in your company has any knowledge of how they are operating?

Ira L. Gre~~n~~inger.

A. Our engineering staff—our technical staff visit them and check them up.

X-Q. 62. And your license agreements provide that you shall have access and full information about these licenses, what they are doing?

A. Yes, I think so.

X-Q. 63. And still you have never acquired any of that information whatever?

A. I personally, or the company?

(WITNESS EXCUSED).

IRA L. GRE~~N~~INGER, called as a witness in behalf of the plaintiff, being first duly sworn, testified as follows:

DIRECT EXAMINATION,
BY MR. WILLIAMS:

Q. 1. State your full name and occupation?

A. My name is Ira L. Gre~~n~~inger; my occupation is that of mining engineer and metallurgist.

Q. 2. Where are you at present employed?

A. I am employed by the Inspiration Consolidated Copper Company at Miami, Arizona.

Q. 3. And what is your position with that company?

A. Acting mine superintendent at present.

Q. 4. And how many men have you under you in your position as mine superintendent?

A. Something over a thousand.

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Q. 5. And about how much ore is mined per day in that mine?

A. From nineteen to twenty-one thousand tons.

Q. 6. Prior to your employment as superintendent of mines, what was your employment?

A. I was employed by Minerals Separation, American Syndicate, Ltd., 1913, to give the full title.

Q. 7. What work did you do for them?

A. I was engaged in demonstrating the flotation process and installing plants in various parts of Canada and the United States.

Q. 8. When did you commence to work on flotation?

A. In the month of July, 1911.

Q. 9. And what did you do in reference to the installation in Canada for the Brittania Mining & Smelting Company?

A. I installed a small test unit at the mill of the Brittania Mining & Consolidated Company, now the Howe Sound Company.

Q. 10. When?

A. In the month of June, 1912, as I remember.

Q. 11. And what kind of ore did you treat in that plant?

A. Their ore is a copper bearing ore, the mineral being in the form of chalcopyrite.

Q. 12. And of what richness in copper?

A. At that time about four and a half to five per cent.

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Q. 13. And in this plant that you installed—in the first place what sort of plant was it?

A. It was a standard Minerals Separation plant of fifty tons capacity?

Q. 14. And what frothing agents did you use in the operations with that ore?

A. Well, I experimented with quite a number of different frothing agents, but I finally came to the use of a wood tar oil known as Stockholm tar, mixed with certain mineral oils.

Q. 15. Did you use acids?

A. I did not.

Q. 16. Or heat?

A. No, I didn't use any heat.

Q. 17. And in what proportion did you use this mixture of Stockholm tar and mineral oil?

A. The average was about two pounds per ton of ore treated.

Q. 18. And what recoveries were made?

A. The recoveries after the experimental stage had passed, were very good, being from 88 up to 95 per cent, and as high 97 per cent at times.

Q. 19. And as to the grade of concentrate that you obtained?

A. The grade was about 20 per cent on an average in copper.

Q. 20. How long did you stay at this plant in connection with this first installation?

A. I remained at the plant until the month of November of the same year, 1912.

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Q. 21. Did you visit the plant again at a later time?

A. Yes, I visited the plant once in 1913, in the month of July.

Q. 22. And what did you find installed at the plant in the way of flotation when you again visited it?

A. They at that time had in operation a 600 ton standard Minerals Separation plant.

Q. 23. And what frothing agents were being used with that plant at that time?

A. They were using the same mixture that I had left with them at the time I left the plant.

Q. 24. And as to the grade and recoveries, what was the condition?

A. The recoveries in the larger plant were somewhat better than in the smaller plant at this time that I was there and had access to the assays.

Q. 25. And was there or was there not any reorganization of other parts of the mill that had taken place?

A. There was.

Q. 26. What was it?

A. Originally the mill consisted of coarse jigs, fine jigs, tables, and vanners, preceded by hand-sorting. After the installation of the large flotation machine they discontinued the hand sorting and the coarse jigs, the tables and the vanners, using their fine jigs. The jig tailings were reground and treated by flotation.

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Q. 27. Did you have anything to do with the installation of flotation at the Inspiration Consolidated Copper Company, where you are now employed?

A. I did.

Q. 28. When did that commence, and what did you first do there?

A. I installed a 50 ton standard Minerals Separation unit for the Inspiration Company in January, 1913, in the fore part of the month.

Q. 29. And how long did you continue there with that installation?

A. With that particular plant I continued until June of that year.

Q. 30. So it was run for six months?

A. About six months, yes.

Q. 31. That was regarded as what sort of an operation?

A. Experimental purely.

Q. 32. For the purpose of demonstrating the usefulness of the process on that ore?

A. Yes.

Q. 33. Were the operations of a satisfactory nature?

A. They were.

Q. 34. What grade of concentrate and what recovery were obtained in those operations when they got down to what was regarded as the better conditions?

A. We usually based our figures on the extrac-

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tions of the sulphide content of the ore, due to the fact that in the ore, at the Inspiration—part of the mineral in it is oxidized in form and is not readily recovered either by flotation or gravity methods, and as to this amount of oxidized ore, the proportion changes in different parts of the mine, our figures are based largely on the recovery of sulphide material, and in the recovery of that material our figures ran from around 88 to well above 90 per cent. Our grade of concentrate varied from 25 to 54 per cent in copper.

Q. 35. What frothing agent was used; what finally was decided upon as the best thing to use?

A. After experimenting with several oils we concluded that cresylic acid was the best, and therefore we used that agent largely, almost exclusively, in the plant.

Q. 36. In what form did you use it, a crude or a pure product?

A. Crude cresylic acid.

Q. 37. You might state whether or not this crude product contained some other material than cresylic acid?

A. Well, I never analyzed it, or never had it analyzed, but from its appearance I should say it did, because it has not the appearance of pure ^{sol}cresol^{etc}, being dark in color.

Q. 38. Cresylic acid is the commercial name for cresol?

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A. That is what I understand.

Q. 39. Did you use anything else as a frothing agent or as a reagent in that operation, than cresylic acid?

A. We experimented with various oils, but did not find any of them as satisfactory as cresylic acid at that time.

Q. 40. Did you decide upon the relationship between the water concentration and flotation as the result of that work?

A. Well, we simply submitted our results to the management of the Inspiration at that time, and they decided.

Q. 41. Well, what did you decide?

A. We tested the relationship of water concentration to flotation.

Q. 42. And what was finally decided upon as the next operation by the management?

A. They decided to install a larger experimental unit, thinking this one was somewhat too small upon which to base their large scale plans.

Q. 43. And did you attend to that installation?

A. I did.

Q. 44. And when was that done?

A. That was in the following year, January of 1914.

Q. 45. And how large a plant was that?

A. That was a standard 600 ton Minerals Separation unit.

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Q. 46. And how long was that standard 600 ton unit operated?

A. That unit, or one that was installed afterwards, was operated up to the time that I resigned from the employ of Minerals Separation, ~~Limited~~, American Syndicate, 1913; ^{Limited} in August, 1915.

Q. 47. That whole operation, was it within the finished mill or outside of the mill that was being built?

A. It was outside of what is now the mill, in a temporary building.

Q. 48. And what is the present flotation installation of the Inspiration Consolidated Copper Company?

A. The kind of machines you refer to?

Q. 49. Well, in the first place their number?

A. They are using three separate sorts of machines.

Q. 50. The number of machines and their style?

A. There are at the present time in operation 19 sections in the mill, four of which are equipped with Callow cells, and one section is equipped with what we refer to as the Hebbard type of Minerals Separation machine. The other sections are equipped with what is known as the Inspiration type of machine.

Q. 51. That latter being a type developed by the Inspiration Company?

A. Developed by the Inspiration Company at that point, in their mill.

Q. 52. How near is the flotation plant to completion; you say there are 19 sections running?

A. Well, as originally planned, the mill consisted

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of 18 sections, and that has been in operation now for over a year, but later they decided to increase the capacity of the mill by two sections, one of which has been put in commission, but the twentieth is not yet in commission—or was not at the time I left Arizona.

Q. 53. What is the capacity, or what is the amount of material that is being treated by these 19 sections that are now at work?

A. The average is above 18,000 tons per day. The highest figure that I recall now is 19,600 or thereabouts, for one day in April, before I left the plant.

Q. 54. The feed, whatever it may be—19,600 tons?

A. Well, I wish to correct that. It should be 18,600 instead of 19,600.

Q. 55. This feed of 18,600 tons or 18,000 tons, is divided in what manner between these 19 flotation sections?

A. Each flotation section gets it as fed direct from a storage bin, from which it passes to the grinding mills which are independent for each section, each being a unit in itself. One has no connection with another.

Q. 56. That is, each section receives one nineteenth of the feed approximately? Is that right?

A. Theoretically yes, that is the way it is intended.

Q. 57. And the feed that is divided into 19 different parts, we will follow in one of the sections. What does the feed enter after it has been divided?

WHEREUPON an adjournment was taken
until 2:00 p. m. May 7th, 1917.

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Monday, May 7th, 1917, 2:00 p. m.

A. In each section it enters one of two ball mills; the feed is again divided, the ball mills working in parallel—ball mills of the Marcy type. Each ball mill is operated in closed circuit, with a Dorr classifier. The oversize is returned to the ball mill, and the under size goes direct to flotation. The oil in the meantime has been added at the intake of the ball mills. Taking a section equipped with Callow flotation machines, for instance, the pulp is conducted to the rougher cells, which may be eight, twelve or sixteen in number; there is a different number in the various sections. These produce a rougher concentrate. The tailings from these cells are classified in a Drag or Esperanza classifier, the slimes being returned for further treatment in another set of Callow cells, and the sands going to the hydraulic classifiers, and thence to tables. The product of the primary roughers, as well as the product of the roughers treating the return slime, are retreated in a set of recleaning cells, four in number for each section.

Q. 58. Now, at the head of the flotation section you say there are two ball mills?

A. Two ball mills.

Q. 59. And the oil is added at the head of the ball mills?

A. It is.

Q. 60. What happens as the pulp flows through these ball mills with the oil in the pulp?

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A. The oil is thoroughly mixed, and the whole receives quite a violent agitation.

Q. 61. Is there any name for that method of grinding the pulp in the presence of the oil?

A. It is usually referred to as modifying during grinding, or as preagitation.

Q. 62. And that is true of all the sections, is it, that there is modifying during the grinding?

A. In all the sections, yes.

Q. 63. Now, in the sections containing the Inspiration flotation machine the pulp passes directly from the grinding mills to the machine?

A. It does, to the rougher machines.

Q. 64. Give a general description of that Inspiration rougher machine?

A. The Inspiration machine may be characterized as a large† launder; it is about 48 feet long by I think about eight feet six inches in width, divided into two units in the center, that is, each section of 24 feet comprises a separate unit, although operated in series. It is about four feet in depth, and is provided with a porous bottom under which air under pressure is introduced.

Q. 65. That porous bottom is made of what material?

A. Of canvas.

Q. 66. Several layers?

A. Yes, a thick layer of canvas.

Q. 67. And compressed air is supplied underneath, and what does the compressed air do?

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A. It acts the same as in the Callow machine; it agitates and aerates the mixture. The pulp flows into the ball mills from a launder provided for the purpose. The concentrate from the rougher machine is passed to a cleaner of the same type, but somewhat smaller than the roughers. The tails from the rougher machine are classified in a Drag or Esperanza classifier, ~~the slimes~~,—the slimes being sent to waste, and the sands given further treatment by tables.

Q. 68. Now, that section containing the Minerals Separation-Hebbard type machine, does the pulp flow directly from the grinding mill to the flotation machine?

A. It does.

Q. 69. In the flotation machine are there revolving agitators?

A. Yes. These particular machines were equipped with ten revolving agitators.

Q. 70. Give a general description of the machine.

A. It is made up of a very long, rectangular box provided with ten agitators, each agitator occupying one-tenth of the length of the box, and above these agitators are arranged a series of iron or steel baffles extending about a foot above the agitators. There are eight projections or baffles around each agitator, eight separate baffles.

Q. 71. And the function of these baffles in these machines?

A. Is to produce a more quiet condition of the water above the baffles than would be possible if the baffles were not there.

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Q. 72. Is air supplied, and if so, how supplied?

A. Air is supplied underneath each impeller or agitator, under pressure from the same system that supplies the Callow machine and the Inspirator machine.

Q. 73. Does this flow through a porous medium?

A. It does not.

Q. 74. Just flows through a pipe?

A. Forced in through a pipe and is broken up in fine bits by the action of the agitator.

Q. 75. That is to say, the agitator performs the function of producing the small air bubbles?

A. Yes.

Q. 76. And you have described one machine. Is this a rougher machine?

A. That is the rougher machine. There are two cleaners provided, both of the same type, excepting they are provided with six agitators instead of ten.

Q. 77. Are they in series or in parallel?

A. They run in parallel when they are both operating.

Q. 78. So that the overflow is divided between the two cleaners?

A. Yes.

Q. 79. And these cleaners produce what kind of a concentrate?

A. They produce the finished concentrate. The tails from the cleaners are passed to the roughers and the tails from the roughers go to the usual classifier arrangement, the slimes being discarded, and the sands treated on the tables.

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Q. 80. And what becomes of the sands from all of these sections of this flotation section?

A. They are all passed over tables.

Q. 81. Passed over shaking tables?

A. Passed over shaking tables made by the Deister Machine Company.

Q. 82. So that in this plant we have all of the shaking table treatment below the flotation?

A. All following flotation.

Q. 83. Was that the result of the tests that you made as to which was the better way of treating it?

A. That was the final decision arrived at on the basis of the tests made.

Q. 84. Now, what kind of an ore is the Inspiration ore?

A. It is a copper bearing ore, the copper being principally in the form of a chalcocite.

Q. 85. And about what proportion of copper is present in the ore?

A. During 1916 the average was about 1.54% copper.

Q. 86. Now, your knowledge of the operations in the flotation plant was carried up to about what time?

A. The latter part of 1915.

Q. 87. What frothing agent was being used in the plant at that time?

A. We were using crude coal tar and cresol oil at that time.

Q. 88. In what proportions?

A. A pound and a half per ton, or less.

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Q. 89. May I ask you if you mean a pound and a half or less per ton of ore?

A. That is what I mean, yes; per ton of ore treated.

Q. 90. In your experience at the Inspiration flotation plant was there any occasion, when the amount or proportion of oil was increased beyond the normal proportion? If so please relate the circumstance or circumstances.

A. Yes, there were several occasions of that kind.

Q. 91. Well, you may take them up as they occur to your mind.

A. The first instance occurred in the early part of the experimental work in 1914, possibly in April. There was a condition which myself and my operators had observed for several days when the froth appeared to be overoiled and the tables following flotation would suddenly become covered with incipient granules, showing that the flotation plant was not performing its function; and the levels of the different compartments of the flotation machine were hard to maintain. I had formed the opinion that this was caused by leakage from a machine, a grinding machine we were using at that time which was known as the Symonds Disc machine, which had a large oil reservoir in its base. In order to test out my theory I took some of the oil that was used in this disc machine as a lubricant and added it to the flotation machine.

Q. 92. In what proportion?

A. At a proportion which I calculated at about 5 pounds per ton.

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Q. 93. The normal food was how much?

A. One and a half to 1.6 per ton.

Q. 94. So the total then was increased to about six and a half?

A. Something over six pounds. This brought about the same condition we had observed previously, which confirmed my opinion as to what was the cause of our trouble.

Q. 95. Was there another occasion of that kind that you recall?

A. Yes, there was another occasion the following year when I added pine oil to the pulp in addition to the regular oil that was being used at that time.

Q. 96. Did you do that intentionally?

A. I did it intentionally, that is, for a purpose of my own, not knowing the effect it would have on the flotation plant.

Q. 97. What was the purpose?

A. The purpose was to dissolve some accumulated tar in a feed pipe which carried the tar into the various grinding mills.

Q. 98. And what was the result?

A. The result was that concentration practically ceased in the flotation plant and there was a great volume of froth produced, but it was very low in grade; in fact, it wasn't much higher grade than the original ore, from inspection.

Q. 99. And how much of this pine oil did you add at that time?

A. Well, as near as I can recollect it amounted to

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about two pounds per ton, during the time it was going in.

Q. 100. And what was the normal feed of oil then?

A. About the same that it was previously as I have testified to, about 1.5 to 1.6 pounds per ton.

Q. 101. Making the total feed about what?

A. About 3½ lbs. per ton.

Q. 102. Now, did you do anything in connection with a flotation plant at the Atlas Mining & Milling Co., and if so when?

A. A flotation plant of 150 tons daily capacity was installed at the Atlas mine near Ouray, Colorado, in the fall of 1913.

Q. 103. What kind of ore was there treated?

A. It was a lead-silver bearing ore.

Q. 104. And about what contents?

A. About 2% of lead and from 10 to 14 ounces of silver as I remember it.

Q. 105. What frothing agents were used in that plant?

A. After the experimental stage, crude carbolic acid was the principal frothing agent used.

Q. 106. in what proportion?

A. A pound to a pound and a half per ton.

Q. 107. Between a pound and a pound and a half of carbolic acid?

A. To the ton of ore treated.

Q. 108. And what recoveries were obtained?

A. The recoveries were about 90% of the lead and

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80 to 85% of the silver at the time I was last at the plant.

Q. 109. And what was the grade of the concentrate obtained?

A. About 20 per cent lead and up as high as a hundred ounces of silver per ton of concentrate.

Q. 110. Now, in all of these operations that you have described, in what manner was the concentrate recovered?

A. In the form of a froth.

CROSS EXAMINATION.

BY MR. SCOTT:

X-Q. 111. You have charge of the flotation operations now at the Inspiration mill, have you?

A. No, not at the present time.

X-Q. 112. What was your first experience with flotation?

A. My first experience with flotation was in the laboratories of the Minerals Separation American Syndicate.

X-Q. 113. When was that, in 1911?

A. Starting in 1911.

X-Q. 114. In July, 1911?

A. Yes.

X-Q. 115. What oils did you use in your first experimental work?

A. Oh, we used a large number of oils, all of which I could not remember. We used cresylic acid and Stockholm tar and various mineral oils, fuel oils.

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X-Q. 116. In actual operations what oils have you found to be used, as far as you can recall them to memory.

A. I have used wood tars, and cresylic acid and various creosote oils, and crude coal tar and other products of coal tar, and pine oils; I think that would about cover the classes.

X-Q. 117. What mineral oils?

A. I have used fuel oil, and a lighter distillate from fuel oil at times, or attempted to use them.

X-Q. 118. What is fuel oil?

A. As we understand it in the west it is the residuum after the lighter ingredients have been distilled off from petroleum, such as kerosene and gasolene.

X-Q. 119. Did you use fuel oil in any of the plants you have been connected with?

A. I have never found it useful in itself, and only once have I used it, after having experimented. I experimented with it and only once have I used it as a steady ingredient of the mixture, and that was at the Britannia Company, ~~which was~~ which is now the Howe Sound Company, British Columbia.

X-Q. 120. And they use it as a steady thing?

A. A portion of the ^{Xme}~~mixture~~, about 25 per cent is made up of it.

X-Q. 121. What was the rest?

A. 25 per cent tar and 50 per cent of distillate of fuel oil.

X-Q. 122. So 75 per cent of the mixture was derived from petroleum?

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A. Yes.

X-Q. 123. And the other 25 per cent was what?

A. Wood tar oil.

X-Q. 124. What was the first working plant that you had experience in?

A. This plant we have just been referring to, the Howe Sound Company at Britannia Beach, British Columbia.

X-Q. 125. When did you go there?

A. 1912.

X-Q. 126. What month?

A. I went there in May, and I installed the plant there in June.

X-Q. 127. What was going on there when you got there in the way of flotation?

A. Nothing at that time.

X-Q. 128. You went there to introduce it?

A. Yes.

X-Q. 129. What did you do first?

A. I set up my plant and went to work on the flotation of ores.

X-Q. 130. What sort of a plant was it?

A. A standard Minerals Separation plant, fifty tons capacity.

X-Q. 131. What is the standard plant like, describe it?

A. This plant was made up of eight agitating compartments and eight spitzkastens, the pulp passing from the first agitation department to the spitzkasten and then back to the next or succeeding agitating depart-

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ment and so on through the plant. Later I cut out—

X-Q. 132. Carried there by gravity?

A. No, it ~~was~~ carried by the action of the impellers.

X-Q. 133. The spitzkasten projected down below the agitating cell?

A. Yes.

X-Q. 134. And you had a pipe leading from the spitzkasten to the next cell, and the pulp was drawn up by the action of the agitators or impellers?

A. That is right.

X-Q. 135. Was that all there was to this machine?

A. That is all, yes.

X-Q. 136. How did it work when you first started it?

A. It worked beautifully.

X-Q. 137. What oil did you use?

A. I think I was using turpentine to start with.

X-Q. 138. What is turpentine made from?

A. It ~~was~~ made from ~~the~~ destructive distillation of Douglas fir wood.

X-Q. 139. It is made about the same way as pine oil, isn't it?

A. Well, I am not an authority on that subject; I suppose it is, but I don't know.

X-Q. 140. What kind of recovery did you make when you first started up this plant?

A. Oh, our recoveries were very high, probably above ninety per cent; 90 to 95 right from the start, while we were working on the particular products that we started on.

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X-Q. 141. What kind of product did you get?

A. We got a concentrate which assayed from 20 to as high as 29 per cent copper.

X-Q. 142. How soon after you first started up your machine did you get such a concentrate and recovery as that?

A. About two hours.

X-Q. 143. Where did you go next?

A. I went to the home office, and then to the Inspiration Mine.

X-Q. 144. Had you experimented with these Britannia ores any in the laboratory before you went there?

A. I had not.

X-Q. 145. Did anybody to your knowledge?

A. I think some others had, yes.

X-Q. 146. And you had their results, I suppose?

A. I had their results.

X-Q. 147. And their recommendations of how to treat the ore?

A. Well, it did not really avail us anything because we were not able to get the oils that we had used in the experimental laboratory; we had to pick up what local oils we could find.

X-Q. 148. Do you know how long an investigation had been made of these Britannia ores which you refer to?

A. The investigation could not have covered more than a week or two, because I have a recollection of the time that the samples were shipped, and it appears to

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me that it was not more than at the outside two weeks before I went to the Britannia.

X-Q. 149. Do you know of any other samples that were shipped before the ones that you knew of?

A. I have not any personal knowledge. I think there were, however, some crude ore samples which were shipped before that time, but that was not the product that I was treating.

X-Q. 150. What were you treating?

A. I was treating a lot of accumulated slimes that had not been found capable of treatment by any other process that they had.

X-Q. 151. How much did you treat at the Inspiration?

A. It was a 50-ton plant, like the Britannia.

X-Q. 152. Was there any flotation there when you went there?

A. No.

X-Q. 153. Your plant was the first?

A. Yes.

X-Q. 154. That was January, 1914?

A. 1913.

X-Q. 155. How long did you experiment with that first plant?

A. Until June of that year.

X-Q. 156. What were you doing during that time?

A. Well, for the first month we were experimenting with the various oils, and getting good, bad and indifferent results.

X-Q. 157. What kind of oils did you experiment with?

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A. We used cresylic acid, and various wood tar oils, and some pine oil and some creosote oil from the Barrett company.

X-Q. 158. Any mineral oils?

A. We attempted to use mineral oils, but found them useless.

X-Q. 159. What oil did you finally decide on?

A. We finally decided on crude cresol or cresylic acid.

X-Q. 160. What kind of results did you get the first month?

A. Well, they were very erratic; they were good at times, and other times not so good.

X-Q. 161. What made them erratic, did you find out?

A. I think experimenting with the oils principally.

X-Q. 162. Getting the right oil?

A. That I think was largely the trouble.

X-Q. 163. Did you alter the machine or its mode of operation during that six months?

A. We altered the flow as to the number of spitzkastens carrying middlings, and we also used tables before the flotation plant and tables following the flotation plant at various times, but the flotation plant itself was never altered.

X-Q. 164. Do you remember the first oil you used at Inspiration?

A. No, I could not say what the first oil was.

X-Q. 165. What oils were they that gave bad results?

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A. Well, it is easier to classify them as to the ones that give good results.

X-Q. 166. That gave bad results I asked you?

A. Well, the wood tar oils were found impossible of use. Pine oil was useful to a limited extent. The creosote oil was of no use whatever—the creosote oil that we had at that time.

X-Q. 167. Can you tell me what mixtures you finally decided on at that time?

A. It was no mixture; it was a straight crude cresol.

X-Q. 168. And that is the oil they use now?

A. No, they are not using that now and have not for a long time.

X-Q. 169. What are they using now?

A. Principally crude coal tar.

X-Q. 170. How much carbonate of copper is in that Inspiration ore?

A. It varies greatly. During 1916 it averaged about .35 of one per cent I think.

X-Q. 171. Did the flotation recover much of that?

A. Very little.

X-Q. 172. Negligible is it? How long after you started ^a Inspiration was it before you succeeded in getting a result good enough to be interesting?

A. It happened on the 19th of January; having started on the 3rd of January.

X-Q. 173. And what was the rest of this six months occupied with up to June?

A. Well, we were checking results and working ores in small lots from various parts of the mine,

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which was very extensive. We would cut samples from various parts of the mine, amounting to a day's run, and run them through the mill.

X-Q. 174. Were there other machines operating there in competition with your standard Minerals Separation machine?

A. Not during this first period.

X-Q. 175. When were they, if you know?

A. Well, it was in 1914 when we commenced to work in the larger plant.

X-Q. 176. Then up to that time they had not decided to adopt this Minerals Separation machine?

A. Not definitely.

X-Q. 177. How long did it remain in a state of indecision?

A. Really, I could not testify as to that.

X-Q. 178. Why was it that they finally fitted up the machine with four Callow units and fourteen Inspiration units and only one Hebbard unit, if you know?

A. I don't understand you.

X-Q. 179. What led to the adoption of the system you describe, 14 Inspiration machines and 4 Callow machines and 1 Hebbard?

A. Well, I can only quote Doctor Gahl as to that.

X-Q. 180. Do not all these machines depend on the introduction of air solely for agitation?

A. Not solely.

X-Q. 181. None of them reach their results by agitation alone, do they?

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A. Why, I consider it so, yes.

X-Q. 182. Which one of them does it?

A. Well, all the agitation—they all have agitation.

X-Q. 183. Which one of them brings it about by agitation without the introduction of air under pressure?

A. I did not mean to make that statement; I said agitation and aeration is performed in all the machines. Some of them introduce the air by means of the mechanical agitation; some by the introduction of air through a porous material.

X-Q. 184. Do you know what patentees the Inspiration Company has licenses from?

A. I do not.

X-Q. 185. Do you know whether they have a license from Minerals Separation?

A. I have second-hand information, that is all.

X-Q. 186. Did you ever see Mr. Callow around the Inspiration plant?

A. Certainly.

X-Q. 187. Have you seen him there lately?

A. Well, lately I am at the mines, and he might be at the plant and I would not see him.

X-Q. 188. How lately have you seen him?

A. Not since 1914.

X-Q. 189. You are not in the mill now?

A. No.

X-Q. 190. Where did they get these Callow machines?

A. They built them on the ground.

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X-Q. 191. Did Mr. Callow supervise their building?

A. He did not as far as I know.

X-Q. 192. Were there any name plates on there of the Callow Company?

A. There probably are, although I have not noticed them.

X-Q. 193. Was this first machine that you put in there which was called the standard Minerals Separation machine, provided with any means for introducing air, other than by mechanical agitation?

A. Not as a steady thing. We attempted to introduce air at times into the machine, but it was not designed in such a manner that it would break up the air into fine enough bubbles.

X-Q. 194. What was the reason, if you know, that the standard Minerals Separation machine was not successful?

A. As I said before I can only quote Dr. Gahl as to that, and he stated that the reason was a very slight difference between the power consumption between the Minerals Separation machine and the various air agitation machines.

X-Q. 195. What is the power consumption, if you know, of the standard machine as compared with the Callow machine of equal tonnage?

A. I could not give you any definite figure as to that.

X-Q. 196. You never looked into that?

A. No, I have had no chance to compare them in an accurate manner.

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X-Q. 197. Now, as I undersand your testimony, the final extraction of mineral from the ore is effected on tables, after the flotation treatment has taken place?

A. A very small portion of the mineral is extracted on tables.

X-Q. 198. But the last of it that goes through after flotation is not that it?

A. That is quite right.

X-Q. 199. Do you, in any of these machines at the Inspiration plant, return any of the concentrates as middlings to the head of the machine?

A. Not strictly speaking, as I understand it, no. The tails from the cleaner machine are returned, of course.

X-Q. 200. Yes, I remenber you said that.

A. Not aside from that.

X-Q. 201. None of the rougher concentrate goes back to the head as a middling?

A. No.

X-Q. 202. How about the practice at the Britannia, did they return any of the rougher concentrate as middlings?

A. During the time I was there I returned two spitzkastens out of the seven or eight, whichever I happened to be using, as a middling.

X-Q. 203. Returned it direct to the head of the machine or back to some tank?

A. Direct to the head of the machine.

X-Q. 204. Now, you have stated certain facts as to the recovery and the grade of concentrates at Inspira-

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tion. If I remember right, if my memory serves me right you did so state. If not, you may state now.

A. As to what period?

X-Q. 205. Well, state recently.

A. I have only the annual report of the company on which to base a statement of that kind, as I am not, as I said, in direct touch with the milling operations at the present time. They give the extraction in their annual report as about 90% of the sulphide; somewhere over 90%.

X-Q. 206. The practice adopted at Inspiration is quite similar to that of the Miami isn't it?

A. I am not familiar with that practice.

X-Q. 207. The Miami mine uses Callow cells?

A. Yes.

X-Q. 208. And at the Inspiration you say they used Callow cells ^{and} ~~at~~ the Inspiration machine. Now, they are quite similar in appearance, aren't they?

A. Both of them are similar.

X-Q. 209. Both of them depend upon introducing the air through a porous bottom?

A. Both types.

X-Q. 210. As distinguished from introducing it by mechanical agitation?

A. They do.

X-Q. 211. The Miami property was started and in operation some year or more before the Inspiration, wasn't it?

A. Several years before.

X-Q. 212. Well, I mean the flotation department?

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A. I don't understand it that way.

X-Q. 213. The flotation department, I mean.

A. At Miami?

X-Q. 214. Yes.

A. Installed before Inspiration?

X-Q. 215. Yes.

A. Oh, no.

X-Q. 216. What was the Inspiration doing at the time Miami started; what kind of machines did they have?

A. They were developing their mine; they didn't commence to produce ore until 1915.

X-Q. 217. Who didn't?

A. The Inspiration.

X-Q. 218. You said, didn't you, you said 1913, wasn't it, that you started there?

A. The first installation of flotation at the Inspiration was 1913.

X-Q. 219. And how long was it before some other type of machine was introduced at Inspiration other than the standard mechanical agitation machine you put in?

A. About a year and a half.

X-Q. 220. That would bring it up, then, to some time in 1914, wouldn't it?

A. During 1914.

X-Q. 221. They then started in one of these air machines with the porous bottoms?

A. Installed the air machine in July, 1914.

X-Q. 222. There was a kind of competition, wasn't

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there, to decide what kind of machines should be put in?

A. Well, yes.

X-Q. 223. Mr. Callow had his porous bottom machine in there and Mr. Towne had his porous bottom machine and you had your mechanical agitating machine?

A. That is right.

X-Q. 224. And after that competition the decision came as to what kind of apparatus to put in?

A. That is correct.

X-Q. 225. Have you got any information that enables you to state daily and average results at the Inspiration Company with these different types of machines?

A. I know the results are very close, but that is second-hand information. Of course really I haven't seen the assays, you know. They are stated to be very close, one machine having no advantage over the other.

X-Q. 226. But finally they decided on these air machines and air machines are now being used, are they?

A. They are using them.

X-Q. 227. And you do not know whether they have any license from anybody besides the Minerals Separation, do you?

A. I do not.

X-Q. 228. Have you any detailed statement at all other than the annual report of the Inspiration Company showing the results from day to day?

A. Well, no, not directly; I get a certain part of

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the work, it comes direct to me each day, but not the extraction, or figures that would show the extraction.

X-Q. 229. What does come to you?

A. Tonnage and assay of feed and assay of oxide and so on.

X-Q. 230. Just the figures relative to the head?

A. Yes.

X-Q. 231. You don't get anything about the concentrates or recoveries?

A. Not officially.

X-Q. 232. How do you get it if you don't get it officially?

A. As I stated a moment ago, I can only give you the figures as published in their annual report.

X-Q. 233. That is all you know about it, is it; the annual reports?

A. Since I left the plant, in the latter part of 1915.

X-Q. 234. How about before the latter part of 1915?

A. I received daily reports of the assays from all machines up to the time I left, concentrates.

X-Q. 235. Have you, in your possession, these reports covering the period of the competition between the different companies that wanted to install flotation there?

A. I have some reports covering a portion of this period.

X-Q. 236. Have you them where you can produce them?

A. I think I can produce some of them.

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X-Q. 237. Please do so.

(Witness produces reports.)

X-Q. 238. Are these all you have on that subject, or simply part of them?

A. These are all I have here.

X-Q. 239. You have more somewhere else?

A. I undoubtedly have reports at home.

X-Q. 240. How long a period do these reports cover that you have in your hand?

A. I am not sure of that; I will have to look at them to find out.

X-Q. 241. I wish you would look at them and tell me, please.

A. I have some daily reports here for August 15. These do not seem to be arranged in order. I don't know what other months will be represented here.

X-Q. 242. Now, if you will just examine them and find out whether they cover a continuous period and between what period; I would like to know.

A. They apparently cover the year 1915 from January to the latter part of August.

X-Q. 243. Now, during that period what machines were in use at the Inspiration?

A. The Minerals Separation standard machine was in use; the Minerals Separation of the Hebbard type.

X-Q. 244. The Hebbard type is the one that takes in air from the bottom under pressure?

A. Yes, a system of Callow cells and what is known as the Flynn-Towne or Towne-Flynn machine and a Cole machine.

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X-Q. 245. What is the Cole machine?

A. It is a machine of the same type.

X-Q. 246. Getting agitation by blowing in air through a porous medium?

A. Yes, sir.

X-Q. 247. How long did this competition between these different processes continue? When did it begin and when did it end?

A. It commenced about July, 1914, as I remember it. The Callow plant was first installed, and I suppose it could have been said to have ended when they decided what they were to install, but as to what time I am not exactly certain; some time in 1915, the early part of the summer of 1915, probably about a year I would say.

X-Q. 248. And when were these machines of the present type installed: when did they begin installing them?

A. They commenced installing them in July, 1915.

X-Q. 249. Right at the end of this competitive run?

A. Toward the end of the competitive run, I should say.

X-Q. 250. Were these other machines taken out upon the termination, and the Cole?

A. Yes.

X-Q. 251. They were not in the mill where they? They were in a separate building.

A. They were in an adjacent building. You might say they were under the same roof. They were not operated possibly the last two or three months. I was

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in the plant. In 1915, during July and August; they discontinued operating all of these plants, including the Callow and the test mill.

X-Q. 252. You haven't any data then on the regular operation of the mill after this plant was decided upon and installed?

A. I have a few sheets here showing the daily operation as long as I was in connection with the concentration department. They had four sections of the mill and they were breaking them in one section at a time. We have first one and two, and then we have the four section.

X-Q. 253. And how long a time do these regular operation reports cover?

A. They probably cover thirty days or more. I haven't looked them over to see.

X-Q. 254. What oil was used during those 30 days?

A. They were using coal tar oil—I mean crude coal tar and creosote.

X-Q. 255. In a mixture?

A. Yes, in a mixture of a small per cent, around 10% I should say of creosote, and the balance was crude coal tar.

X-Q. 256. Will you give me for the first of the days in that period of regular operations the assay of the headings as well as the tons concentrate and the recovery, figured on sulphides?

A. The recoveries are not given. I would have to check them to give you the recoveries. Just the assays.

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X-Q. 257. Give me the assays, then.

A. Just the Callow and Separations, ~~was~~^{were} operated on that day, which was January 1st. Feed to flotation, total copper 1.86; oxidized copper, .28; general concentrates, 22.66; Minerals Separation flotation concentrate, 25.08; rougher concentrate to subaeration, that is the Hebbard mill, 16.8, table—sand table, 3%; tails from recleaning plant flotation 12.04—that would be tails from the cleaner, flotation tails were, first shift, .25; second shift, .34; third shift, .25; oxidized copper, .26; general tails, plant, .29. That is the general sample covering the entire 24 hours, including oxidized copper. In the Callow plant the assays were: Feed, 1.37; flotation concentrates, 31.08; rougher concentrate, 17.26; tails from cleaner, 6.60; table concentrate, 24.6; flotation tails, first shift, .078; second shift, .070; third shift, .085; oxidized copper, .18; oil per ton treated, .70 pounds. That was an off day.

X-Q. 258. Do you find a day when they were both treating the same?

A. Most any other day would have been the same, yes. There seems to be a period when the Callow machine had something the matter with it. Here we have one day, January 11, 1915.

X-Q. 259. The same material? Be sure before you start reading all of them.

A. No, that wasn't the same material. This appears to have been a long series of tests for the different plants—where the different plants took the feed from separate mills. They are practically parallel, but

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it wasn't a case where the feed was divided between the mills.

X-Q. 260. Are there any instances where the same feed was divided between the Callow and the Minerals Separation?

A. There must be long periods covered by that condition. Here again is a case of divided feed, taking the feed from separate mills.

X-Q. 261. Well, suppose you read us that month; tell us what the feed was, and the date.

A. The date was February 22nd, 1915. Assays of head total copper, 1.37; oxide, .30%; general concentrates, 24.34%. That is the combined concentrates from all flotation machines and tables. Flotation concentrates finished, 22.2; rougher concentrates, .18.44%; cleaner tails, 9.58%; flotation tails, Mineral Separation, first shift, .42; second shift, .47; third shift, .35. To the Callow plant the feed was the same feed. Callow flotation concentrates, 23.86%; rougher concentrates, Callow, 16.8%; cleaner tails, Callow, 4.40%; general tails or flotation tails, Callow, first shift, .~~3~~⁶7; second shift, .48; third shift, .48. These were the general tails.

X-Q. 262. Now that is over the tables?

A. Yes, that is over the tables.

X-Q. 263. Can you give the details of the day's operations?

A. The sheet states that Minerals Separation^{and} ~~in~~ Callow plant started up at nine, M.S. ~~X~~ took feed from upper mill, tube mill and No. 10 Hardinge mill, using

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about 27.5 tons per hour; Callow plant took feed from No. 11 Hardinge mill about 10.5 tons per hour; Minerals Separation were treated on flotation slimes table, ^{act side} all the concentrates from flotation retreated on 50-ton plant; Callow plant tails were retreated on sand tables, west side; oil added to dry feed, before it was divided between the upper mill and the Symonds disc.

X-Q. 264. To your knowledge was the Callow machine ever overloaded; that is, run with too much tonnage during these tests?

A. Why, not that I recall at the present time.

X-Q. 265. Can't you refresh your memory from these reports?

A. It may have happened before at times. ~~There were,~~ ^{As} is noted by these reports, there were continuous changes on the feed from various mills to the various points. Of course I have no recollection of it at the present time. I would have to read these notes to find what actually occurred at the time?

X-Q. 266. What becomes of the tails of the rougher treating slimes from the Esperanza Classifiers in the Callow section?

A. Tails from the—

X-Q. 267. Roughers which are treating in the slime from the Esperanza classifiers.

A. They pass to waste.

X-Q. 268. They go to waste?

A. Yes.

X-Q. 269. What becomes of the cleaner cell product in the Callow system?

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A. First to filter and dewatered.

X-Q. 270. And how about the tails?

A. Tailings are returned to the rougher.

X-Q. 271. What rougher?

A. The Callow rougher.

X-Q. 272. The very first machine?

A. Yes.

X-Q. 273. Doesn't go to any tank or anything first?

A. Goes direct from the launder right into the machine.

X-Q. 274. Do you know what the reason is that the Hebbard machine was not used in all the sections?

A. I can only give a conclusion, and that is because it was installed too late in the test plant. The results were in and I suppose they had arrived at a conclusion by the time the Hebbard plant was installed.

X-Q. 275. Has oil ever been added to the pulp after it comes from the ball mill?

A. There have been times when a small portion of the oil was added to the pulp after it comes from the ball mill.

X-Q. 276. What was the result?

A. It had no particular effect on the result as far as I know because there was always the majority of the oil added before the ball mill, that is before grinding. This was simply a secondary operation amounting to a very small portion of the oil.

X-Q. 277. Is the agitation in the ball mill as violent as in the Hebbard machine?

A. I couldn't make a comparison as to that.

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X-Q. 278. How many times per minute does the ball machine rotate?

A. It rotates about 15 times per minute.

X-Q. 279. And what is the speed of the impeller in the Hebbard machine, revolutions per minute?

A. I ran at various speeds; I ran the Hebbard up to an average there, about 300 revolutions per minute.

X-Q. 280. Did you get any practical recovery with it in froth, in the way of pulp, as it came from the ball mill?

A. In what manner?

X-Q. 281. Running it out of the ball mill into the spitzkasten?

A. Never tried it.

X-Q. 282. You didn't think it was worth trying, did you?

A. I shouldn't consider it so.

X-Q. 283. Could you make a little sketch illustrating the flow as you described it on direct, through the Callow machine, the Hebbard machine, and the Minerals Separation machine and the Inspirator machine, in the Inspiration mill?

A. I can have such a sketch made for you.

X-Q. 284. You can do that could you, just with a pencil, when you are off, and bring it back?

A. I will have it made under my direction.

X-Q. 285. You described it, but it would be much clearer if you made a sketch, I think.

A. Yes.

X-Q. 286. At the time that you added pine oil as

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you stated, and got a violent, poor froth, did you make any change in the amount of aeration or dilution of the pulp?

A. I didn't make any change whatever.

X-Q. 287. Simply changed the amount of oil without changing these other factors?

A. That is all.

X-Q. 288. Have you any information as to the effect of changes in dilution and aeration on the amount of oil necessary?

A. In my practice I have always attempted to hold to a given standard of dilution and the work being in the nature of experiment and test work, I have been able to hold very closely to that particular point when it was once set so that I have not had what might be called experience in a wide variation of pulp dilution.

X-Q. 289. And how much of a range in the matter of aeration has your experience covered?

A. It is very hard to measure the aeration brought about by the beating in of air mechanically.

X-Q. 290. Well, the speed of the impellers; what range of speed of the impellers does your experience include?

A. In the standard machine we have operated it at about 12 to 14 hundred peripheral feet per minute—not a very wide range.

X-Q. 291. And kept within that range?

A. Yes.

X-Q. 292. That is about as close a range as it is practicable to keep within?

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A. I think so.

X-Q. 293. And how about your experience in the degree of aeration in the machine where air is introduced through a porous medium, such as in the Callow machines, the Inspiration and the Hebbard?

A. The Hebbard requires a very low pressure of air because the impellers have a tendency to draw the air in, so it matters very little as long as the supply of air is available for the impellers, whether there is much pressure or not. With the Callow and other machines I have simply observed them as others have operated them, and I have had no experience with them.

X-Q. 294. Did you describe the flow of the pulp at the Britannia plant?

A. I don't believe I did.

X-Q. 295. Is it simple enough to illustrate—Do you think you could make a sketch of it?

A. I would have a very hard time making a sketch of it. I have had men pass through that plant and swear they couldn't make a sketch of it to save their life.

X-Q. 296. So complicated?

A. It was at that time, yes.

X-Q. 297. What made it so complicated?

A. The various classes of machines used, the great number of various types.

X-Q. 298. I don't understand.

A. A great number of various types of machines

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that were used in the plant there, being coarse jigs, fine jigs, tables and vanners—

X-Q. 299. (Interrupting.) I meant the flotation part of it.

A. The flotation is simply the regrinding fines from the jigs and the whole goes through agitating compartments and spitzkastens right straight through the whole machine.

X-Q. 300. Run right straight through a series of machines and ~~that~~ may be one or two spitzkastens coming back as middlings?

A. That was the practice, yes.

X-Q. 301. How did you determine the pounds of pulp for the net flotation results?

A. By experiment.

X-Q. 302. Yes, but I understood you to say that you had kept within a very narrow range of dilution.

A. My practice has been that that particular range, say from 25% of solids up to a maximum of 32 or 33%, gives the best results on all ore.

X-Q. 303. Did you ever work at all, outside of that narrow range?

A. I have at the Britannia works at times, when I had no control over the dilution, when I was getting feed from the mill and in a way I couldn't control it when the dilution was no doubt less than 20% solids.

X-Q. 304. But you never worked outside of these limits when you could help it?

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A. No, sir.

X-Q. 305. Ever use Jones oil at the Inspiration?

A. No.

X-Q. 306. Ever use California crude oils?

A. I have attempted to use them.

X-Q. 307. California topped oil?

A. That is virtually the same oil; I never have used an oil by that name.

X-Q. 308. How fine was the material crushed in the ball machine at the Inspiration? Approximately; what screen analysis?

A. They use a very coarse screen as their standard which does not give so much information as one would like. They state that there are so many per cent. on 48 Tyler Standard screen, and don't give us much information—I have no doubt some screen analysis covering the time that I was there, but I can't remember now just what the finer sizes were, or what the percentage of the finer sizes were.

X-Q. 309. Is the water in the tailings returned for use in the mill at Inspiration?

A. It is carried to a slime settling pond a mile or more from the plant and after a period of settling is pumped back to the plant.

X-Q. 310. Any determination ever made as to how much oil was in that water that is pumped back?

A. Not to my knowledge.

X-Q. 311. While you were attempting ^{to develop} the process for the Inspiration Company, did you get any

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information regarding operations in other companies, other mills, to help you?

A. Why, what was sent to me at times from the office at San Francisco in regard to what others were doing; that is, other members of the Minerals Separation staff; other than that I did not.

X-Q. 312. I meant regarding the practice developed at other mills?

A. No.

X-Q. 313. Did you obtain such information in any way.

A. Only by the installation of these machines. Other than the Minerals Separation machine at the Inspiration plant.

X-Q. 314. Any iron sulphide in the Inspiration ores?

A. Very little.

X-Q. 315. Did the Inspiration Company have others besides you working on the application of flotation in their ore?

A. Not at the time of my first work at the Inspiration. The first six months period the Inspiration was simply represented by a gentleman who checked our results. Starting the large plant, the company had their present metallurgist, Dr. Rudolph Gahl at the plant, and he has been there continuously since.

MR. SCOTT: That will be all.

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RE-DIRECT EXAMINATION,

BY MR. WILLIAMS:

R-Q. 316. Now, in the standard machine of Minerals Separation such as you have described, where does the air come from that gets into the pulp?

A. It comes from the surface and goes down in a vortex which forms around the impeller shaft, when the ~~rotation~~^{agitation} has reached a certain speed.

R-Q. 317. And I have a suggestion for that kind of aeration as to the name, supra-aeration. Will you adopt that name?

A. I think it describes it.

R-Q. 318. In the Hebbard type of machine where does the air come from?

A. It is brought in from below, the opening being under the center of each impeller.

R-Q. 319. ~~And there~~—And that has a name has it not?

A. That has.

R-Q. 320. What is it?

A. We term it sub-aeration.

R-Q. 321. Now the Callow cell, is this ~~in~~^{the pulp} in that not sub-aerated?

A. I would consider it so.

R-Q. 322. And in the Inspiration machine is that or is it not sub-aerated?

A. It is sub-aerated.

R-Q. 323. Who was president of the Inspiration

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Consolidated Copper Company at the time of this competition that you have just testified about?

A. I think Mr. Thompson was president at that time.

R-Q. 324. And he is the man, Mr. William B Thompson, he is the president of the Callow Company?

A. I think he is.

R-Q. 325. Now, what becomes of the slimes from the Minerals Separation machine in the Inspiration plant?

A. After classifying, the slimes are passed to waste; the sands being passed over tables.

R-Q. 326. And what is the result of that as to the coarser particles? The coarsest particles go first through what?

A. The coarser particles are dragged by this drag classifier and are then carried to a hydraulic classifier where they are again classified and distributed.

R-Q. 327. And about what proportion of the recovery is made on those tables?

A. During my time at the plant the proportion of recovery only amounted to two or three per cent of the total recovery.

R-Q. 328. And everything else is made on flotation?

A. On flotation.

R-Q. 329. I did not ask you on direct about an installation at the Old Dominion Copper Company. Did you make an installation there of flotation?

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A. I did.

R-Q. 330. What was the installation?

A. That was our usual experimental apparatus, the 50 ton standard unit.

R-Q. 331. How long were you with that plant, and what results did you obtain?

A. I was with the plant about two months in the latter part of 1913.

R-Q. 332. What did you decide upon as the frothing agent to be used?

A. We used a number of oils experimentally, as we usually did, but cresol and the like products gave the best results, such as creosote or cresol.

R-Q. 333. Was that or was it not a difficult ore to treat by flotation?

A. It was a very difficult ore, from the fact that it contained a large amount of clay, and also a very large amount of oxidized copper in proportion to the amount of copper in the ore.

R-Q. 334. How would you describe that ore of the Old Dominion mine?

A. Treatment by flotation was a very difficult matter, and I warned the company when I installed the plant that they probably would not get very good results but as the material we were treating was absolute waste to them at that time, and we were able to get fair extraction, around fifty per cent of the total copper, they were very much taken with it, and decided to install a plant, which has since greatly in-

Ira L. Greininger.

creased their extraction, although on different ore.

R-Q. 335. Isn't that ore there mostly smelting ore?

A. Yes; their concentrating is secondary to the smelting ore. When it gets below a certain grade it goes to the concentrator, but above that grade it goes direct to the smelter.

RE-CROSS EXAMINATION,

BY MR. SCOTT:

R X-Q. 336. Do you know William B. Thompson?

A. I do.

R X-Q. 337. Was he president of the Inspiration Company when the big mill was built?

A. As far as I know he was.

R X-Q. 338. Do you know that?

A. I don't know for a certainty.

R X-Q. 339. You don't know when his term of office started, do you?

A. I think he has been president of the company continuously since.

R X-Q. 340. But you don't know that?

A. Only by the reports.

R X-Q. 341. You don't know anything about his being president of your own knowledge?

A. Well, I suppose that would be the best evidence anybody would have, not having been present at the directors meeting, was to see his name on the annual report.

R X-Q. 342. Do you know who is president now?

A. Mr. Thompson is.

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℞ X-Q. 343. You have been told so I suppose.

A. Well, I was talking to Mr. Thompson about three weeks ago, and that came up in the conversation.

WITNESS EXCUSED.

GEORGE A. CHAPMAN, called as a witness in behalf of the plaintiff in rebuttal, being first duly sworn, testified as follows:

DIRECT EXAMINATION,
BY MR. WILLIAMS:

Q. 1. You are the same George Albert Chapman who testified in the suit of Minerals Separation against Hyde, are you not?

A. I am.

Q. 2. In your testimony in that suit you carried your connection with flotation installation up to about the summer of 1912, when the testimony in London was closed?

A. Yes.

Q. 3. Now, will you take up that record and continue with it; what did you do after that time in installing flotation concentration of ores; what was the next thing you did?

A. Well, in December, 1912, I came to the United States of America and proceeded to Miami, Arizona, and there assisted Mr. Greninger in his first tests at the property of the Inspiration Company. I stayed there for a period of about three months and then

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I came to Butte to assist in the demonstration before this court at the argument of the Hyde case. After that I returned to Miami for a period of another eight or ten weeks, till the tests of the 50 ton plant were completed. They were completed in either the month of June or July, and from there I went to San Francisco and worked in the laboratory of Mr. Nutter, testing ores for clients of the company.

Q. 4. That was the laboratory of Minerals Separation, American Syndicate?

A. Yes. Then about September I left for Chili, South America, via New York, to assist Mr. Walter Broadridge.

Q. 5. And who was Mr. Broadridge?

A. The chief engineer of Minerals Separation at London—in the reorganization of the concentrator at the Braden Copper Company. When I reached there, there were seven 600 ton standard Minerals Separation machines in operation, and the results had not come up to expectations; but these poor results were soon traced to the bad milling conditions in the upper part of the mill, and were not at all due to any of the work in the flotation section. Before remodeling that mill, we had handed over to us for testing purposes a 500 ton mill in which we were allowed to carry out our tests in order to satisfy the officials of the Braden Copper Company that we could improve their general milling practice. The recovery in this old mill at the time of our arrival was in the neighborhood of sixty-

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five per cent or a little above that. In our first month's work we raised that recovery to either 79.8 or 79.9 per cent of the total copper contained in the crude ore. The following month the recovery was slightly in excess of eighty per cent. It was after the successful demonstrations in this mill that Mr. Pope Yeatman, who was present on the property consented to the reorganization of the larger mill. This reorganization was well in hand at the end of December, and the only trouble then that they had apparently was the collection of the flotation concentrates. Having in mind the hearing of the argument in the appeal court at San Francisco, I completed my stay at Braden, and on my return, at Lima I received a cablegram from the New York office, asking me to visit the El Cobre mines in San ^{tiago}~~Diego~~,—near San ^{tiago}~~Diego~~, Cuba.

Q. 6. You said that the recovery was as to total copper; what did the ore contain in copper; anything besides sulphide?

A. Oh, yes, it contained some carbonate and oxide.

Q. 7. And what was the recovery in sulphide copper?

A. Well, I should say between ninety and ninety-five per cent.

Q. 8. Now, as to the El Cobre mines in Cuba?

A. I found there a mill that was operating on about 500 tons of copper ore, assaying four per cent cop-

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per, and installed in that concentrator was one standard 600 ton M. S. machine, the recoveries being obtained at that time were improved to the neighborhood of about eighty per cent total copper, and I made certain recommenadtions and promised the management that they would get a recovery of about eighty-five per cent, which I think they have succeeded in doing since.

Q. 9. Was there or was there not an oxidized copper constituent in that ore?

A. Well, the trouble with that ore was that a lot of material that was hauled from under ground contained large quantities of filling of old tailings that had been used in old stoping operations.

Q. 10. That was a very old mine, was it not?

A. Very old.

Q. 11. Do you know how far it goes back historically?

A. I could not say, but it was very old, and it was the presence of these old tailings that was causing considerable difficulty in the mill. I left Cuba for New York, and then returned to Miami, Arizona, where Mr. Greninger had already got the 600 ton testing plant in operation. I stayed there a few weeks, and then visited the property of the Consolidated Arizona Copper Company at Humboldt.

Q. 12. You have heard Mr. Greninger's testimony in regard to the operations at the Inspiration. Are you in agreement with what he said?

George A. Chapman.

MR. KREMER: We object to that form of question, asking one witness if he agrees with another.

MR. WILLIAMS: It is just to save time.

MR. KREMER: He has not seen the operations, he has only been there part of the time.

Q. 13. On your first visit to Inspiration, how long did you stay there?

A. About three months.

Q. 14. And during that three months were the operations of the flotation plant successful?

A. Entirely successful.

Q. 15. And about what recoveries were made?

A. Why, they varied considerably, according to the part of the mine the ore came from, but I should say from memory that they varied from 85 to 95 per cent recovery of the sulphide mineral present. There was one occasion when we got as high as 97 per cent copper. This recovery of course varied as we were treating daily 10 ton lots of ore which were being taken from all parts of the mine, to allow the management to fully appreciate the value of flotation to them as to the whole of their ores.

Q. 16. Did you introduce at Inspiration any method of treatment in connection with flotation?

A. I did.

Q. 17. And what was it that you introduced?

A. I introduced a method which was known as modifying during grinding, which was an improvement on a previous preagitation method.

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Q. 18. And that was patented to you, was it not?

A. It was.

Q. 19. And the patent belongs to Minerals Separation, Limited?

A. Yes.

Q. 20. Now on your second visit to Inspiration how long did you stay there?

A. A few weeks only.

Q. 21. And operations were being carried on while you were there?

A. The operations at that time were partly a combination treatment of water concentration and flotation, and partly total flotation treatment. Mr. Greninger and myself took separate shifts, and for a few weeks we had a friendly contest as to which was the best method, and I think it was finally agreed that the total flotation gave practically the same results as water concentration plus flotation. If there was any little balance, it was in favor of water concentration plus flotation, for the reason that on days when the crushing was too coarse, the wet concentrating tables recovered a few extra per cent of copper by saving the over size mineral.

Q. 22. And in those operations where was the water concentration in relation to flotation?

A. Both before and after, according to the flow sheet being employed.

Q. 23. And what frothing agent was used then and in what proportion?

A. Cresylic acid was the chief agent used, and

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occasionally we had in combination with that, pine oil and turpentine, and it was used, if I remember correctly at the rate of about one and a half pounds per ton of crude ore treated.

Q. 24. Now, we will take up the Consolidated Arizona Copper Company, where is that?

A. At Humboldt, Arizona.

Q. 25. And what did you find there, and what did you do there?

A. I found a 100 to 150 tons standard Minerals Separation machine operating on a copper ore. My visit was purely one of inspection to see if I could assist them in any way.

Q. 26. Did you study the operations?

A. Yes.

Q. 27. What frothing agents were used while you were there and in what proportion?

A. Well, if I remember correctly, there was quite a number there—I would have to refer to notes.

Q. 28. What proportion?

A. I can't recollect the exact proportion; it was very low; it was in the usual amount that we used at that time.

Q. 29. Well about how much?

A. Between two and four pounds per ton.

Q. 30. Do you remember what recoveries were obtained while you were there?

A. I do not recollect them, but I can give them to you by referring to my notes.

(Recess.)

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Q. 31. I think I misled you as to the title of the Consolidated Arizona. I will ask you now if the proper title is not the Consolidated Arizona Smelting Company?

A. That is correct.

Q. 32. Now, will you give me the information that you were not able to recollect in the last few questions.

MR. KREMER: Pardon me, Mr. Williams, but I would like to make an inquiry; these figures that Mr. Chapman is giving represent milling operations, do they, under our stipulation?

MR. WILLIAMS: Oh, yes.

MR. KREMER: I want to inquire to avoid the necessity of objecting; they are not tests; they are milling operations?

MR. WILLIAMS: Oh, yes.

Q. 33. What were these operations at the Consolidated Arizona while you were there?

A. They were the usual daily milling operations.

Q. 34. And you gave them study for the purpose of what?

A. Increasing their recovery.

MR. KREMER: I think that is covered by our stipulation.

Q. 35. I think I asked you about the frothing agents used?

A. The frothing agent used at that plant was a mixture of fuel oil and stove oil and Carolina turpentine.

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Q. 36. In what proportion?

A. It varied between two and three pounds per ton.

Q. 37. How about the recoveries?

A. The recovery we obtained at that time was in the neighborhood of eighty per cent, and has increased considerably. On my last visit to Consolidated Arizona in 1916 the recoveries were 93 or 94 per cent.

Q. 38. Was there oxidized copper?

A. Very little.

Q. 39. So it did not figure to speak of?

A. The sulphide copper was practically the recovery that we got. The mineral was a little tarnished, of course.

Q. 40. Could you give me the percentage of the three oils which were used in the proportion of two or three pounds per ton of ore, fuel oil, stove oil and Carolina turpentine?

A. Well, I have no definite notes on that, but speaking from memory—about 50 per cent of the mixture was Carolina turpentine and the other 50 per cent was divided between the stove oil and the fuel oil, the major portion of which was fuel oil.

Q. 41. Now, up to this period have you covered the various installations made by you?

A. Yes.

Q. 42. What was the next work that you did?

A. In June, 1914, I again came to this district to carry out large scale tests of the products from the Washoe concentrator of the Anaconda Copper Com-

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pany. These were started in the month of June, 1914. About the same time Senator Clark's Timber Butte mill was about to be started up, and as much spare time as I could devote to that I spent at the Timber Butte mill.

Q. 43. Did you study the operations of the Timber Butte mill?

A. I did.

Q. 44. And what in general was the nature of those operations as to the frothing agents used?

A. We started up on pine oil, and oleic acid, in the neighborhood of one pound per ton, and we got very good results right from the start.

Q. 45. About what percentage of recoveries?

A. Well, I think the first week's results was over ninety per cent of recoveries.

Q. 46. But you gave the greater part of your time to the Anaconda work?

A. The Anaconda work, because Mr. Tom Owen was at Timber Butte looking after our interests at that time, and I spent perhaps three half days a week in that mill.

Q. 47. What was the nature of the work at Anaconda?

A. I was to carry out a complete investigation on a practical scale of the applicability of flotation to their slimes, and also to their sand tailings. The first work we undertook was on the Anaconda slimes, and we succeeded in getting very encouraging results.

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which lead the officials of the Anaconda Company to recommend the installation of a large flotation plant for the treatment of this product. After successfully demonstrating the process on these slimes, it became a matter of investigation whether it would be more economical to treat the straight slimes or the tailings from the Round Table plant, which was then in operation on that product. Our tests demonstrated that the operation would be much more simplified if we treated the Round Table feed direct, and plans for an installation on a very large scale were proceeded with. In the meantime, the success of our work on the slimes influenced our friends at Anaconda to investigate the possibilities of the treatment of sand tailings and to compare the results with the leaching process which was then in operation. As a result of these tests it was decided to reorganize the whole of their concentrating and increase their tonnage to 15,000 tons per day of crude ore. The upper part of the mill had slight modifications. It was decided to treat all tailings from the tables by regrinding them and subjecting them to flotation treatment. Eight sections of the mill were so changed, and each section had installed in it four 600 ton standard M. S. machines. Each part of the flotation section would treat in the neighborhood of 1350 tons a day, using only three machines, and keeping one machine in each section as a spare.

Q. 48. What became of that Round Table plant?

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A. The round table plant was scrapped as soon as the slime flotation plant was put in operation.

Q. 49. How long did you stay at Anaconda?

A. On and off I made Anaconda my headquarters until just before Christmas of 1916.

Q. 50. You were present during all this great work of installation?

A. I was present a good deal of the time.

Q. 51. And represented Minerals Separation, Limited?

A. I did.

Q. 52. Or the American Syndicate?

A. Yes.

Q. 53. What was the method of the relation of water concentration to flotation?

A. You mean at Anaconda?

Q. 54. At Anaconda?

A. The tailings, after treatment through jigs and tables, were reground in a Hardinge mill, and the reground product passed direct to the flotation machines. At the head of these machines was added wood creosote and kerosene ^{acid} ~~and~~ sludge, with sulphuric acid, and the usual methods of flotation were followed out. The concentrates recovered from the flotation machine passed to a system of Dorr thickeners, the product of which went through to Oliver filters, and after filtration by these machines the concentrates were mechanically conveyed to railway cars ready for the smelter.

Q. 55. Where did the slimes go from the slime plant?

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A. The feed for the slime plant was separated in the upper part of the mill.

Q. 56. By what means of mechanism?

A. By means of an Anaconda classifier. The slimes were then passed to the original 'Dorr thickening plant which was employed for the thickening of the slimes in the original round table treatment. It was not necessary to alter the condition of this thickening plant, as the economical pulp thickness derived from settlement was quite suitable for both the round table plant and the flotation treatment, namely, in the neighborhood of 14 to 15 per cent solids. The same reagents were used in the slime flotation plant, as in the reground tailings flotation plant, and very high recoveries were obtained. The concentrates from the slimes flotation plant were handled in the same manner as the sand flotation plant.

Q. 57. Now, what you have described is what part of the mill treating what ore?

A. It treats the ore from the Anaconda mines at Butte.

Q. 58. What kind of ore?

A. Copper ore.

Q. 59. Now, was there an installation of a plant for zinc ore?

A. There was one installation made last year at Anaconda.

Q. 60. You might briefly describe that plant; that was under your superintendence and in your presence?

George A. Chapman.

A. Yes. This plant had a rated capacity of 2000 tons per day. The method of treatment was total flotation, and was unique on account of the absence of any water concentrating device in the zinc concentrate.

Q. 61. What does the mill consist of, the flotation mill?

A. The mill consists of the usual coarse crushers, Hardinge mills, Dorr classifier and the products from the Dorr classifier pass direct to flotation machines, where one retreatment of the concentrate was given.

Q. 62. And no water concentration at all?

A. Absolutely no water concentration at all in this mill. The absence of water concentration was a distinct advantage in the capital cost of the concentrator and also in the working cost, which I think has never been approached in this district.

Q. 63. In this particular instance, as to this plant, what is done with the zinc concentrates?

A. The zinc concentrates are filtered and were for some months treated by the new electrolytic methods at Anaconda, but now those concentrates are shipped to Great Falls, where they are treated in the new electrolytic plant in Great Falls.

Q. 64. That is to say the zinc is not produced by smelting—but by electrolytic deposition?

A. ~~Electric~~ deposition. *Electrolytic*

Q. 65. Did you have any competition during the long period of testing or preparation and installation in this plant?

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A. Yes; we had a representative of Mr. Callow's present, who was testing out the Callow machines on practically the same feeds as those we were doing our flotation work on.

Q. 66. Are any of those Callow machines now in the plant?

A. They are not.

Q. 67. Now, is there any other installation that you can refer to as made by you or examined by you?

A. Yes, sir. In 1916 I made several visits throughout the country, and I visited again the Inspiration, the Old Dominion, the Consolidated Arizona, the St. Joseph Lead Company's property at St. Joseph, Missouri, the Doe Run Lead Company and also visited the Cripple Creek district and inspected the flotation operations of the Portland mine, Gold Mining Company, and the installation at the Vindicator Gold Mining Company, and also visited an installation at Leadville, owned by Mr. McDonald.

Q. 68. And were or were not all these places at which flotation was installed under the direction of your company?

A. They were installed under the direction of our company.

Q. 69. What did you find at the Old Dominion Copper Company?

A. They had a standard M. S. machine in operation.

Q. 70. Was it operating in a satisfactory manner?

A. Well, in 1915 they had considerable milling dif-

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facilities, and they were only operating the mill two shifts a day, and we made certain recommendations in a report to Mr. Nutter, which he conveyed to Mr. Beckett, general manager of the Old Dominion Copper Company, and in the following year when we visited the Miami district at the time of the trial or the preparation for the trial against the Miami Copper Company, I again received instructions from Mr. Nutter, stating that Mr. Beckett had asked me to visit their flotation plant, which I did. I found the work considerably improved, and that they had carried out many of the recommendations we made the previous year.

Q. 71. Now, in all your experience in the installation of Minerals Separation concentration processes the world over, of which you have testified, Australia, Sweden, Finland, Chili, South America, Canada, Cuba, and the mining districts of the United States, what is the largest amount of frothing agent that you ever used in any regular operations at a plant?

A. The largest I recollect ever having been used was that at the Old Dominion plant.

Q. 72. And how much was that?

A. Between six and seven pounds per ton.

Q. 73. And what was their frothing agent?

A. I would like to refer to some reports. This report is dated May 21st, 1916, from the Old Dominion period. In that report I mentioned that the average for the first 15 days of April, 1916, the oil consumption average was as follows Coal tar 6.18 pounds per

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ton; coal tar creosote, 0.52 pounds per ton; pine oil, 0.20 pounds per ton; turpentine, 0.26 pounds per ton.

Q. 74. And what you referred to was the document which you now hold, which was your report to Mr. Nutter dated May 21, 1916; is that correct?

A. That is it.

MR. WILLIAMS: The document is offered to defendant's counsel for inspection. That is all.

CROSS EXAMINATION.

BY MR. SCOTT:

X-Q. 75. Did you state what the composition of the ore was where you used the oil that was last referred to by you? If you did not, I wish you would.

A. Well, it was copper ore and the feed to the flotation machine contained about 70.5% of Al_2O_3 ^(Alumina). That is in connection with the getting of the determination of the clay contents of the ore.

X-Q. 76. And did you give the copper; did you tell us before what form the copper was in?

A. The feed averaged 2.55% copper. This was in the form of sulphide chiefly.

X-Q. 77. What kind of a concentrate?

A. The concentrate averaged 18.38% of copper, 22% of iron, 28% of sulphur and 25% of insoluble. The tailings averaged .76% total copper. the extraction was 73% copper.

X-Q. 78. You gave us before that oil composition?

A. Yes, I gave that.

X-Q. 79. Have you got the iron in the feed?

George A. Chapman.

A. No, I don't think I have, Mr. Scott—No.

X-Q. 80. You stated that when you arrived at Braden things were not coming up to expectation. What was the trouble?

A. Well, comparatively the whole trouble was in bad superintendence of the milling operations.

X-Q. 81. And how about the flotation itself?

A. The flotation plant itself was mechanically correct but the feed being delivered to the machine at the time I arrived could not be considered at all suitable for any successful operation.

X-Q. 82. What was the trouble with it?

A. The feed was very irregular. The size of the feed delivered was found to be much too coarse. There were constant shut downs owing to power trouble, and the constant starting up of the flotation machines after being shut down under load, naturally caused bad work in that section.

X-Q. 83. What is fuel oil, petroleum oil? Is it mineral oil?

A. I should say so, yes.

X-Q. 84. And stove oil also is mineral oil?

A. Is a mineral oil—In a more purified form.

X-Q. 85. Any reagent such as salts or acids used at Inspiration?

A. Not to my knowledge.

X-Q. 86. You do not know of any mineral reagent being used there?

A. No.

X-Q. 87. How about old Dominion?

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A. Sodium sulphate has been used and caustic soda has been used.

X-Q. 88. And how about the Timber Butte?

A. Timber Butte, chiefly sulphuric acid. That is the only reagent I have noticed outside of oily reagents.

X-Q. 89. And the Anaconda?

A. Sulphuric acid entirely.

X-Q. 90. No others?

A. Well, no, occasional tests with sodium sulphate, and at one time when I was away from Anaconda they ran one section of the mill for some time with caustic soda.

X-Q. 91. What was their regular practice, do you know?

A. Sulphuric acid.

X-Q. 92. Alone?

A. Alone.

X-Q. 93. And the Arizona Consolidated, what mineral reagents, if any?

A. Sulphuric acid.

X-Q. 94. And the ore treated at the Timber Butte mill was very similar to that of the Butte & Superior was it not?

A. It used to be but not now.

X-Q. 95. Are you sure that you do not know of any mineral reagent being used at Inspiration?

A. Not at any time when I have been there. The only time was in the early days of 1913 when we certainly did try out acids and alkali, but in practical operations I know of none.

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X-Q. 96. What exactly did you mean by saying that the ore treated by the Timber Butte mill used to be similar to the Butte & Superior but is not now?

A. Why, of course I am judging the samples of Butte & Superior ore by those that we have come in contact with in the various suits. Of course the first time I visited your mill was last Sunday week, and I can only say that the ore that was going through the mill on that occasion apparently contained a great deal more clayey material than any material I have ever seen pass through the Timber Butte mill.

X-Q. 97. And in the past when you have had opportunity to compare the two ores you did notice that difference?

A. I didn't notice any remarkable difference.

X-Q. 98. What was your first operation when you started in to apply this process of Minerals Separation to the Anaconda slimes laboratory work?

A. I beg your pardon?

X-Q. 99. —laboratory work, the first thing?

A. No, I never conducted a single laboratory test in the Anaconda before starting.

X-Q. 100. You started with a 50-ton Minerals Separation machine?

A. No, it was a standard 200-ton Minerals Separation machine which of course would have its capacity much reduced owing to the thickness of the pulp that we were about to treat. Its capacity on sand would be 200 tons per day but on slimes only 60 or 70 tons per day.

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X-Q. 101. You said something about 15% solids?

A. About 15% is a good average.

X-Q. 102. And what per cent did you have at the beginning of your operation?

A. Well, for the first few days of course we went through the usual trouble of selecting reagents and naturally tried to avoid the use of sulphuric acid but after a few days of experimenting it was evident that sulphuric acid in this treatment greatly simplified matters and we went straight ahead to get the best reagent to combine with sulphuric acid.

X-Q. 103. And what do you refer to by "reagent to combine with sulphuric acid"?

A. I refer to the oily reagents.

X-Q. 104. And to what oils did you direct your energies, in that direction?

A. Well, the main oils of course at that time were creosote, pine oil, kerosene acid sludge. We also tried reagents in various forms,—feeding them directly to the machines, also by pre-agitating them, adding them to the machine straight. We tried the effect of a compound by the name of argol, adding that to the machine.

X-Q. 105. A-r-g-o-l?

A. Yes.

X-Q. 106. What is that?

A. That is a crude acetate of potassium. It is a by-product from the wine industry.

X-Q. 107. What oils were they using on the occasion of your last knowledge of the work at Anaconda?

P. 4113, L. 9, insert "and two pounds of acid sludge.
That figure for creosote " after " osote "



George A. Chapman.

A. Acid sludge and creosote.

X-Q. 108. And what quantity were they using?

A. That I can't say, but I can get that for you definitely, perhaps.

X-Q. 109. What quantities were they using the last time you have knowledge of?

A. Possibly two pounds of each, two pounds of creosote may be rather high. I would prefer if you would allow me to refer to my reports.

X-Q. 110. What is this acid sludge? An oil or an acid, which?

A. It is a by-product from the paraffine industry. I have never really gone into it fully, but in simple language I should say it was a solution of oil in acid, sulphuric acid, which is in itself soluble in water, although the original oil in the acid-oil mixture is insoluble in water.

X-Q. 111. Are you the George A. Chapman who was sent to the Sulphide Corporation at Broken Hill, Australia, in 1904?

A. I am.

X-Q. 112. Did you meet Mr. James Hebbard there?

A. I did.

X-Q. 113. What process was Mr. Hebbard using at that time?

A. Why, beyond the ordinary wet concentration method?

X-Q. 114. Yes.

A. I don't know of any other process.

X-Q. 115. Who was Mr. Hebbard?

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A. Mr. Hebbard was the manager of the Sulphide Corporation, Central Mine.

X-Q. 116. Don't you know that Mr. Hebbard had been doing something with the Cattermole process?

A. I don't think Mr. Hebbard ever did any tests on the Cattermole process until I arrived.

X-Q. 117. When did you arrive?

A. Why, in 1904.

X-Q. 118. Did you work with Mr. Hebbard?

MR. WILLIAMS: It is respectfully submitted that the witness is not being cross examined on matters in relation to which he was examined on direct. He may have testified in the Hyde suit, but certainly not as to any matters that were brought out in this direct examination. His testimony started with 1912. Counsel now carries him back to 1904, his experiments in Australia, and matters that apparently are not in any way germane to the direct testimony. I object to the question as irrelevant and unwarranted and not proper cross examination.

MR. SCOTT: The witness testified about operations throughout the world and that is what I am cross examining him about. I should not think the counsel could claim the privilege of confining the cross examination to any particular year. The examination is on the subject as to what processes have been in use.

THE COURT: Well, when he was testifying about world-wide operations he was testifying about the process in suit, and all the operations of the process in

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suit, South America, Australia, etc., that he had not known to be used more than 6 or 7 pounds of oil to the ton. I think you are getting a little beyond the legitimate cross examination.

MR. SCOTT: The plaintiffs have examined him directly in an effort to show the court, or an attempt to show the wide application of this process to the exclusion of others. My questions are directed to negative that inference.

THE COURT: Well, but you are going outside of it. You may ask him anything in connection with this process, whether it has been used in Australia. It would not negative the use of the process in Australia if they had also used the Cattermole process or if the gentleman mentioned had. I think I will sustain the objection of that question.

MR. SCOTT: Exception.

X-Q. 119. Did you state, Mr. Chapman, that at the time of your visit to Inspiration they were making a recovery of 85% to 95%?

A. That was the first three months, in the experimental part.

X-Q. 120. And what recoveries are they making now?

A. I couldn't say, Mr. Scott. You see my visits have been very occasional since then.

X-Q. 121. Do the figures that you gave take into account the percentage of oxides in the tailings when speaking of the recovery?

George A. Chapman.

A. These figures refer to the recovery of sulphides; I thought that was understood.

X-Q. 122. Maybe you did say that. Was the slime and reground sand feed ever mixed and sent to the flotation plant as a mixed product at Anaconda?

A. Yes, it has been tried.

X-Q. 123. What grade of flotation concentrate did that make at Anaconda?

A. Well, the concentrates from the sand plant varied from 30 to 35 insoluble material, and from the slime plant a little more. In this particular instance I was given to understand that it was not necessary to improve the grade beyond this; that it was fully suitable to their smelting requirements.

X-Q. 124. Did you ever use this stove oil and fuel oil at Anaconda, under your direction?

A. Oh, yes.

X-Q. 125. For what periods of time?

A. Why, right throughout the testing period, we used a little stove oil to assist in the uniformity of the work of the plant.

X-Q. 126. And that recovery which you have given of 85 to 95% on the sulphide content would be about what on the copper content as a whole?

A. Shall I take an average recovery of 90% of the sulphide for the purpose of this calculation?

X-Q. 127. Yes.

A. In the neighborhood of 77% of the total copper.

X-Q. 128. Can you make flow sheets for this, just pencil sketches of the Braden, Timber Butte, Anaconda

George A. Chapman.

and El Cobra plant, as last seen and described by you?

A. The Braden, the Timber Butte, Anaconda and El Cobra?

X-Q. 129. Yes, with a description of what comes into it?

A. Yes.

X-Q. 130. Did you do any work on the concentrates and tails on the round table at Anaconda?

A. Not the concentrates, but the tailings.

X-Q. 131. Now, have you named all the oils that you can remember that were used at Anaconda, particularly all the mineral oils? I think I referred to the stove oil and fuel oil.

A. Yes.

X-Q. 132. Any other mineral oils?

A. None that I remember.

X-Q. 133. Have you noticed any relation between the amount of oil and the dilution of the pulp?

A. Certainly.

X-Q. 134. And what has that been, according to your observation?

A. That was very clearly demonstrated when we were doing the work on the round table, the feed compared with the round table tailings. The round table tailings at Anaconda of course contained more water than the round table feed, and naturally the amount of reagents had to be increased.

X-Q. 135. Increased with the greater dilution?

A. Greater dilution of the pulp.

George A. Chapman.

X-Q. 136. And by the term "reagent" you include oil?

A. Oily reagents.

X-Q. 137. Will you state the size to which you ground in both the copper and zinc plants of the Anaconda?

A. Well, the aim at Anaconda in the copper separation was to get a product through 60 mesh, but of course in the beginning of the operation they had considerable trouble with the regrinding section. The source of supply of pebbles for the grinding mill and tube mill was certainly cut off by the shipping troubles on account of the European war and for many months experiments had to be carried out with a substitute on the various ores instead of the pebbles. Does that answer your question?

X-Q. 138. You did not refer to the zinc, did you?

A. Why the zinc plant, most of that work has been done since I left Anaconda.

X-Q. 139. Any of it done while you were there?

A. Why, I could get at records to give you these figures, but I don't recall them quite well now.

X-Q. 140. Have you any idea of what the approximate screen analysis would be of material that was simply ground to go through a 60 mesh? That is, how fine would it be?

A. Well, it all depends on the method of ^{re}grinding. But assuming an ordinary Hardinge's mill grind—

X-Q. 141. (Interrupting) Is that what they used at Anaconda?

George A. Chapman.

A. Well, all except one section where there was a tube mill installed. I should say between 38 to 42% would pass through a 200 mesh screen.

X-Q. 142. Have you any idea as to how much would go through 100?

A. No, but I can give you absolutely definite figures.

X-Q. 143. Well, now, if you have got them convenient I would like to have them.

A. Certainly.

X-Q. 144. Do you know anything of your own knowledge about the results of the Callow process at Anaconda? By "Callow" I mean the processes using the vessels with the canvas or other porous bottoms, and the injection of air under pressure?

A. Yes, I know that such cells were installed beneath the Minerals Separation standard machines in the mill, and were intended for the retreatment of Minerals Separation concentrates, but we did quite some interesting work and we proved that we actually got a cleaner concentrate by returning the middlings to the Minerals Separation machine instead of sending them to the Callow machine, and the middlings from the Callow machine, being returned to the head of the Minerals Separation flotation machine. The Minerals Separation machine alone produced a grade of concentrates that was more satisfactory to the officials at Anaconda.

X-Q. 145. What grade zinc concentrate does the Minerals Separation machine make at Anaconda? That is, what per cent of zinc?

George A. Chapman.

A. Well, of course that varies considerably, as you know. The Anaconda Company are opening up quite a number of zinc mines, and the ore delivered to Anaconda of course is very patchy, but we have tried to keep the insoluble content of the ore between 5 and 6% and I think that is a general and a fair statement of what this concentrate actually contains.

X-Q. 146. Can't you state it in terms of zinc, what the range of zinc per cent would be?

A. Yes, I would say that that would go between 32 to 40% of zinc.

X-Q. 147. 32 and 40?

A. Yes.

X-Q. 148. Well, can you give any example of the heads? You said it was patchy, but wasn't there some of the ores that you can give us an idea about as to what they ran in zinc?

A. Yes, they have varied between 13—to as high as 17 and 18 and perhaps 19% of zinc on occasions. It is generally maintained at about 15%.

X-Q. 149. Didn't the Anaconda Company have quite a force of engineers working on flotation problems?

A. At what time?

X-Q. 150. Well, at the time they were contemplating its introduction?

A. No. The only gentleman I know that was doing any work at all on the proposition was Mr. Ralph Diamond.

George A. Chapman.

X-Q. 151. No one else on the Anaconda force worked on flotation to your knowledge?

A. Not to my knowledge, and I don't believe there was.

X-Q. 152. About what period of time elapsed between the first test of slimes at Anaconda and the first satisfactory results?

A. Why, possibly two or three weeks; maybe less, but that is again very indefinite. I have a paper by Messrs. Laist & Wiggin, which states it very definitely.

X-Q. 153. Was this Mr. Diamond working on flotation when you came to Anaconda to make your tests?

A. He had, I believe, been doing some work in the laboratories of the Butte & Superior Company.

RE-DIRECT EXAMINATION

BY MR. WILLIAMS:

R-Q. 154. Who is Mr. Laist?

A. Mr. Laist is now general manager of the Washoe Reduction works at Anaconda.

R-Q. 155. And who is Mr. Wiggin?

A. Mr. Wiggin is general superintendent of copper concentration for Montana for the Anaconda Copper Company.

R-Q. 156. These zinc ores of Anaconda—of the Anaconda, in what manner were they treated before flotation was adopted?

A. They were never treated.

R-Q. 157. And why not?

A. Why the ores were of such a complex nature.

George A. Chapman.

R-Q. 158. What was the complexity?

A. Why, the complexity consisted of—chiefly of the other minerals combined with the zinc.

R-Q. 159. That is to say in what form, sulphides?

A. Sulphide form.

R-Q. 160. That is to say, in connection with the zinc sulphides there were other sulphides?

A. Yes.

R-Q. 161. And what was the principal one; what was the principal one of them?

A. Iron pyrite, chiefly.

R-Q. 162. And these concentrates that they recover now, would they be marketable for smelter purposes?

A. They would have to have a good smelter contract to be able to ship less than 35% zinc concentrates to the east.

R-Q. 163. And as a matter of fact, as you said, they are treated by electrolytic processes?

A. Yes.

R-Q. 164. And that gives a different grade of zinc does it not, from the smelter process?

A. It gives the purest zinc that has been known.

R-Q. 165. And that electrolytic treatment is by electricity obtained from what?

A. Water power.

R-Q. 166. So that the whole problem of the treatment of these ores involves the water power for electricity and flotation in the treatment of an ore which would be otherwise untreatable? Is that correct?

George A. Chapman.

A. That is so.

R-Q. 167. Now, you gave an example of an increase of frothing agent ^{accomplished} ~~accomplished~~ by an increase in the dilution of the pulp. Did that frothing agent contain soluble constituents?

A. It did.

R-Q. 168. Can you recall any example where, employing an insoluble frothing agent you found that the increase in the dilution of the pulp required an increase in the amount of the soluble frothing agent?

A. No, I can not.

R-Q. 169. Now, in the various plants that you have referred to in your testimony were there any Minerals Separation sub-aeration machines?

A. Yes. I have seen one installed at the Braden Copper Company and at the Inspiration Copper Company. I have seen machines of that type in the Dutch Sweeney mine in California, Utah Leasing Company, Utah, and we did have one in experimental practice at Anaconda.

R-Q. 170. What sort of an ore is that in the Dutch Sweeney?

A. Pyritic gold ore, assaying between three and four dollars per ton.

R-Q. 171. That is the ore?

A. That is the ore, yes.

R-Q. 172. Do you know what the concentrate was?

A. The concentrate would vary from thirty to forty dollars per ton, but nearer \$40.00 per ton.

R-Q. 173. Are there any other examples within your experience of the treatment of gold ores?

George A. Chapman.

A. Yes, in the Cripple Creek district.

R-Q. 174. And silver ores?

A. No, not silver ores alone.

R-Q. 176. And what are the other varieties of ores to which you have applied or seen applied the froth flotation process?

A. Why, the lead ores of the Missouri district—I think that is about the only other variety I have seen.

R-Q. 177. So it is zinc ores, lead ores, copper ores and gold ores and some of these zinc and lead ores contain precious minerals?

A. Precious minerals.

R-Q. 178. Gold and silver?

A. Gold and Silver, yes, sir.

R-Q. 179. Now, in all of these processes that you have described is there agitation, aeration with the use of amounts of frothing agent of six or seven pounds to the ton of ore or less, and froth recovery of the mineral?

A. There is.

MR. WILLIAMS: That is all.

RE-CROSS EXAMINATION

BY MR. SCOTT:

RX-Q. 180. Have you any information one way or the other regarding the relation between insoluble oil and solubles?

A. Yes, I can give the instances at Braden where we thinned out the pulp considerably and we were not

George A. Chapman.

able to decrease the amount of fuel oil that was used but we were able to decrease the amount of European wood tar oil. Later on we did effect an economy of the fuel oil by atomizing the oil before we added it to the flotation machine; but the economy in the fuel oil was proved absolutely not to have anything to do with the thickness of pulp.

X-Q. 181. Have you any compilation of figures upon which you can base such a conclusion?

A. I base that on memory now. I know they are absolutely correct.

X-Q. 182. You never made a compilation of figures and studied the results, did you?

A. Never.

X-Q. 183. When you went to the Anaconda Company, were you shown the reports and figures compiled by Mr. Diamond in his investigation of flotation?

A. I don't recollect that, Mr. Scott.

MR. SCOTT: That is all.

X-Q. 184. MR. WILLIAMS: Did you ever draw a curve on the subject about which you have just been cross examined?

A. No.

X-Q. 185. MR. SCOTT: Mr. Chapman, did you talk to Diamond about his work in flotation when you came to Anaconda?

A. Yes, we had a general conversation, but the extent of our conversation was this that Diamond said that he had been doing flotation tests, and beyond that

Maxwell W. Atwater.

I had no knowledge of the results he had been getting.

X-Q. 186. Didn't he describe to you how he had proceeded and what he had done?

A. He told me that he had been using the slide machine in some tests.

X-Q. 187. And did Mr. Diamond tell you where he had conducted his investigation?

MR. WILLIAMS: I think that what Mr. Diamond told Mr. Chapman is incompetent.

THE COURT: I will sustain the objection.

X-Q. 188. MR. SCOTT: Do you know where Mr. Diamond conducted his investigations?

A. He told me that he conducted them in the laboratory of the Butte & Superior Copper Company.

(WITNESS EXCUSED).

MAXWELL W. ATWATER, Recalled as a witness in behalf of the plaintiff in rebuttal, testified as follows:

DIRECT EXAMINATION

BY MR. WILLIAMS:

Q. 1. You have heretofore testified as a witness at this trial, Mr. Atwater?

A. I have.

Q. 2. Your name has appeared in the list of licensees of Minerals Separation, Limited, and Minerals Separation, North American Corporation; are you such a licensee?

Maxwell W. Atwater.

A. I am such a licensee.

Q. 3. And have you conducted operations under that license?

A. I have conducted such operations.

Q. 4. When did those operations commence?

A. July, 1914.

Q. 5. What material was it that you treated?

A. At that time, zinc tailings.

Q. 6. And where had those zinc tailings come from?

A. They were left over from the operation of the Butte & Superior Copper Company in the concentrator at Basin belonging to the Basin Reduction Company.

Q. 7. And with those operations of the Butte & Superior Copper Company at Basin, Montana, as the result of which these tailings were produced, were you *at the time* not in charge of those operations?

A. I was the Butte & Superior Company's general superintendent at that time.

Q. 8. Over how long a period have those operations extended?

A. A little over two years.

Q. 9. When did they stop?

A. In May, 1912.

Q. 10. And do they or do they not represent all the operations of the Butte & Superior Company with water concentration alone?

A. Almost entirely; there was some flotation conducted there.

Maxwell W. Atwater.

Q. 11. During 1911?

A. Yes, sir.

Q. 12. But except for that it was all water concentration?

A. Entirely, yes.

Q. 13. And did you mention the number of tons of material treated in those operations?

A. Yes; we milled 300,000 tons of ore at Basin.

Q. 14. As the result of the milling by water-concentration of 300,000 tons of ore, what quantity of tailings were actually produced?

MR. KREMER: We object to this as incompetent, irrelevant and immaterial, and not related to any of the issues in this case. I don't know whether we have a right, but I think we should be allowed ~~to~~ ask what is the purpose of this testimony. I don't want to insist on an objection if there is any reason.

THE COURT: What is the object of this testimony?

MR. WILLIAMS: The object of this testimony is to show that before the Butte & Superior Copper Company adopted flotation, their operations produced a great mass of tailings, and that this witness took those tailings, or what was left of them after they had been on the dump for years, and by the use of this process in suit, made a fortune out of it. I think that is relevant.

MR. KREMER: That does not in any way refer to infringement.

Maxwell W. Atwater.

MR. WILLIAMS: It refers to utility; it is proof of utility.

THE COURT: It shows utility of the process and the extent to which it has been used. Objection overruled.

Defendant excepted.

A. There were left some fifty or sixty thousand tons of tailings on the dump at Basin. I haven't in mind right now how many actual tons of tailings were produced.

Q. 15. But all that you found there were from fifty to sixty thousand tons?

A. That's about all, yes.

Q. 16. And you know, do you, or do you not, that some of those tailings had been removed, or had otherwise gone?

A. Certainly; I know that the greater part of those tailings were gone; they had gone down the river and had been hauled away.

Q. 17. Now, what was the zinc content of these fifty or sixty thousand tons of tailings?

A. They averaged about 14 per cent zinc.

Q. 18. How long had they been on the dump before you commenced to operate on the dump?

A. Well, the mill shut down in May, 1912, and we commenced operating in June, 1914, that is over two years at least.

Q. 19. With this material what was your method of treatment?

Maxwell W. Atwater.

A. Regrinding and flotation with an M. S. Standard machine.

Q. 20. Was there a cleaner machine that you used with it?

A. We used a sub-aeration cleaner machine to clean the concentrate that was made on the M. S. Standard flotation machine.

Q. 21. And that sub-aeration cleaner machine, that was not a Minerals Separation machine, was it?

A. No, it was not. We call those the Fagergren-Green Cones.

Q. 22. And that was a type of machine in which there was sub-aeration. In what manner was the sub-aeration carried on?

A. Air was introduced through these cones through a porous brick at the bottom of the cone.

Q. 23. Above that porous brick was there anything in the nature of an agitator?

A. Yes, we had a slow moving agitator above the porous brick.

Q. 24. That was the cleaner machine?

A. That was the cleaner machine.

Q. 25. Now, what sort of results did you get in this process as you carried it on in grade of concentrate?

A. We made a pretty good grade of concentrate there. Our average grade in treating those dumps was better than 54 per cent. I remember six months when we ran steady over 57 per cent.

Q. 26. And in regard to the recovery, what percentage of recovery or extraction?

Maxwell W. Atwater.

A. Ninety per cent of recovery, and perhaps a little better.

Q. 27. What frothing agents did you use?

A. We first used oleic acid and sulphuric acid. Later we used on the zinc pine oil, crude turpentine and sulphuric acid.

Q. 28. Did you or did you not use heat?

A. We used heat always, yes.

Q. 29. In what proportion did you use the oleic acid, pine oil and turpentine generally?

A. When we used oleic acid we ran about six pounds of oleic acid to the ton of ore and if I remember rightly from two to four pounds of sulphuric acid. When we used turpentine and pine oils we use between one and two pounds of oil either mixed together or separate, and as high as fifteen pounds of acid. At times when the tailings were dirty we used more acid than fifteen pounds to the ton.

Q. 30. What has become of that dump; is any of it left?

A. No, there is none of it left.

Q. 31. You have treated it all?

A. We have treated it all.

Q. 32. By flotation?

A. By flotation.

Q. 33. Under the Minerals Separation license?

A. Yes, sir.

Q. 34. And the metal was all recovered in what form in the process?

Maxwell W. Atwater.

A. In the form of concentrate.

Q. 35. And in the machines it appeared as what?

A. As a froth.

Q. 36. What was the profit of that operation per ton of concentrate produced, taking into account what you paid as royalty and what it cost you to treat the dump?

A. Well, we cleared about \$45.00 a ton for the concentrate over all expenses.

WHEREUPON an adjournment was taken until Tuesday, May 8th, 1917, at 10:00 A. M.

Tuesday, May 8th, 1917, 10:00 A. M.

MAXWELL W. ATWATER, resumed the stand for further

DIRECT EXAMINATION,
BY MR. WILLIAMS:

Q. 37. You have described, Mr. Atwater, your operations of changing the dumps of the Butte & Superior Company into concentrates. What other operations have you carried on employing the flotation process under license from the Minerals Separation, Limited?

A. After finishing up the zinc dumps at Basin we commenced treating the old tailings from the Heinze operations in Basin prior to 1906.

Q. 38. With what kind of ore?

P. 4133, L. 25, insert " Three pounds of the mixture of oil
to the ton of ore," after " ore "

Maxwell W. Atwater.

A. They were Butte ores, copper ores.

Q. 39. And what is the copper content of the dump?

A. Averages about 1.25 per cent copper.

Q. 40. And are they the dumps of wet concentration operations?

A. Yes, sir.

Q. 41. Are you working them now?

A. Yes, we are working those now.

Q. 42. In treating this copper material by the froth flotation process, what is your procedure as to reagents? The same or different from what it was with zinc?

A. It is about the same. We use a different mixture of oils. We are running on what we call an acid circuit, the same as with the zinc.

Q. 43. That is you are using sulphuric acid?

A. Yes, sir.

Q. 44. Are you using heat?

A. We are using heat, yes.

Q. 45. And what oils are you using and in what proportion?

A. We are using a mixture, pine oil, tar oil, hardwood creosote, sludge acid and some kerosene; and in quantities of about three pounds to the ton of ore. The acid we use is about eight pounds per ton of ore.

Q. 46. Well, now, in this mixture you use how much kerosene to the ton of ore?

A. Oh, less than a quarter of a pound of kerosene to a ton of ore.

Q. 47. You said tar. What kind of tar?

Maxwell W. Atwater.

A. Tar oil I said.

Q. 48. About how much of that to the ton of ore?

A. Maybe half a pound to the ton of ore.

Q. 49. What is the principal component of the mixture?

A. What is known as Cleveland Cliff creosote; it is a hardwood creosote.

Q. 50. What kind of recovery are you making?

A. Very close to ninety per cent, sometimes above that.

Q. 51. And what grade of concentrates are you producing?

A. The concentrate runs from—our concentrates will average nine per cent copper.

Q. 52. What is the grade of the concentrate in the copper? That is to say, how much of the concentrate in the copper?

A. You mean what is the sulphide content?

Q. 53. No, what is the copper content of the concentrate?

A. About nine per cent copper.

Q. 54. And that concentrate is sent by you to a smelter?

A. Yes.

Q. 55. And it is presumably profitable of course; of course it is a profitable concentrate?

A. We are making money on the operation, yes, sir.

Q. 56. And are there other materials present besides copper in the concentrate?

Maxwell W. Atwater.

A. Yes, about an ounce of silver to the unit of copper. That would be nine per cent copper and nine ounces of silver in a ton of concentrate.

Q. 57. Then are there any other metals that are not counted as valuable in the concentrate?

A. Yes, there is always a little iron present in the concentrate that they don't pay for.

Q. 58. Have you made a computation based upon the operations of the Butte & Superior Copper Company in the treatment of these 300,000 tons of ore at Basin, practically wholly by water concentration, for the purpose of determining what would have been the added profits of the Butte & Superior Copper Company if they had employed, instead of water concentration, the process of froth flotation, as you carried it out later; have you made such a computation?

A. Yes, I have.

Q. 59. And what was the conclusion as to that computation?

MR. KREMER: We object to this for the reason that it is incompetent, irrelevant and immaterial, and has gone beyond the scope of what counsel announced that this character of examination would precede, for the purpose of showing utility. This is not an action in accounting, and we object to this testimony for that reason. We are not prepared to meet a matter of that sort; it is not within the issues.

THE COURT: I can not see that it has very much value, there are so many factors which enter in, the price of metals and all those things. What is the basis for this computation?

Maxwell W. Atwater.

Q. 60. This computation was made, was it not, based on the prices of metals at the time that this ore was milled?

A. Yes, that was the basis of my computation.

Q. 61. What familiarity have you with the prices of metals and the value of concentrates in zinc particularly?

A. Well, of course I knew the terms of the contract with the Butte & Superior, and I have my own contracts with the smelter, and I have seen other contracts between smelters and the operators.

Q. 62. Isn't it a fact that you are familiar with all the elements that go to determine the value of this concentrate made at Basin, Montana?

MR. KREMER: That is objected to as calling for a conclusion of the witness. It is very apparent that there must be a number of assumptions before any computation can be made.

THE COURT: Let us see; this witness was in charge of operations at the time; and he says he knows the contract and the prices.

MR. KREMER: I don't think I made myself clear, your honor. There must be an assumption. As I understand the question it was the difference between the profits that would have accrued with flotation and those which would have accrued made by concentration.

MR. WILLIAMS: Between those which did accrue.

THE COURT: I think he can answer. It may not

Maxwell W. Atwater.

be much value, but it may in a very practical fashion show the utility of the process.

MR. KREMER: The only thing that I have in mind is meeting this matter. If we go into that whole matter it will take time.

THE COURT: Oh, no; the objection will be overruled.

Defendant excepts.

Q. 63. Now, Mr. Atwater, if the Butte & Superior Copper Company had used froth flotation instead of water concentration, what sum of money would have been added to their profits or their net returns?

MR. KREMER: In addition to the objection last interposed I desire to interpose the further objection that it is not proper rebuttal. If it had been their purpose to show utility of the process, it was a part of their case in chief, if it has any place in the case at all.

THE COURT: No. All they had to show in chief, was the patent, as a matter of fact, and there would be a presumption of its validity until you attacked it. Perhaps it is not so much now a question of utility as of anticipation. In the Hyde case it was partly a question of utility as well. The objection will be overruled.

Defendant excepted.

MR. KREMER: Over what period of time does the question cover, Mr. Williams?

MR. WILLIAMS: That has all been covered; the treatment of these 300,000 tons of ore.

Maxwell W. Atwater.

MR. KREMER: During the time that Mr. Atwater was there?

MR. WILLIAMS: Mr. Atwater was there all the time; that has appeared.

THE COURT: Answer the question.

A. Over a million dollars.

CROSS EXAMINATION

BY MR. KREMER:

X-Q. 64. Over what period of time, Mr. Atwater, did you make this estimate?

A. The period of time the Butte & Superior was milling its ore at Basin, 1910, 1911 and about a month or two of 1912.

X-Q. 65. How many flotation operations were being conducted in and about this vicinity at that time?

A. Only one that I know of.

X-Q. 66. Where was that?

A. At Basin.

X-Q. 67. The one that you were conducting for the Butte & Superior?

A. Yes, sir.

X-Q. 68. You were the general superintendent?

A. Yes.

X-Q. 69. And you had charge of their milling department?

A. Yes.

X-Q. 70. Had the dictation of policy as to what processes would be adopted?

A. Yes.

Maxwell W. Atwater.

X-Q. 71. And why didn't you recommend the adoption of flotation at an earlier date?

A. Because I hadn't heard of flotation at an earlier date.

X-Q. 72. It was not in general usage was it, Mr. Atwater?

A. No.

X-Q. 73. You were one of the very first men to install flotation upon a commercial basis or an operating basis in the United States, were you not?

A. I believe so.

X-Q. 74. As a matter of fact you were the first, were you not?

A. Well, I don't know that I was the first

X-Q. 75. You were very close to the first?

A. Yes.

X-Q. 76. And now when you say that if Butte & Superior had adopted flotation instead of proceeding with wet concentration methods at Basin they would have made over a million dollars, by that you mean that if they had adopted the use of flotation prior to the time that they did they would have made a million dollars? Is that what you mean?

A. I mean that if they had started using flotation when they started to concentrate the ores at Basin, if they had used flotation instead of wet concentration from the start of their operations at Basin until they finished, that their profits would have been increased a million dollars.

X-Q. 77. And they started operations at Basin in 1910?

Maxwell W. Atwater.

A. January, 1910.

X-Q. 78. Of course, Mr. Atwater, in making your computation, you have estimated all of the costs attendant upon the milling operations, haven't you?

A. Necessarily so.

X-Q. 79. Transportation and all?

A. Yes.

X-Q. 80. You have made no allowance in these figures for the fact that in 1910 the ores from the mine would have to be hauled by wagon team down to the spur, the railroad spur in Meaderville and then be loaded on to cars and transported to Basin on local freight rates, have you?

A. I didn't have to change the mining figures and the ore ~~loading~~ ^{hauling} figures at all in that computation.

X-Q. 81. Well, I asked you if you figured in the transportation in your excess profits and I thought you said yes.

A. Why, I took the mining costs as they were in figuring these.

X-Q. 82. Well, did you charge your transportation costs to milling or to mining? You certainly didn't charge your transportation cost to mining?

A. Certainly not. I charged them to transportation.

X-Q. 83. And in estimating the mill costs, did you figure in transportation as an element?

A. Certainly.

X-Q. 84. You did?

A. Certainly.

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X-Q. 85. That cost was very high, wasn't it, Mr. Atwater?

A. Yes, indeed.

X-Q. 86. So that I may understand you, Mr. Atwater, you mean that if the Butte & Superior had adopted flotation in 1910 and continued flotation up to the time that it actually did adopt flotation, that its profits would have resulted in a million dollars in excess of what they were?

A. I mean that ^but with the proviso that while operating flotation they had done as well in recoveries as we did—as, we will say, I did at Basin afterwards.

X-Q. 87. How many years afterwards, Mr. Atwater?

A. The milling operations I have just finished testifying about.

X-Q. 88. That is several years ago?

A. That started in 1914, yes.

X-Q. 89. There was great advancement, was there not, in the results obtained by the use of flotation during that period?

A. There was a great advancement in my own knowledge of flotation.

X-Q. 90. That is to say that you were enabled by the experience acquired in the use of the flotation process and by the application of mechanical and engineering processes to effect a greater degree of recovery and to make a higher grade of concentrate? Isn't that true?

A. Yes, that is true.

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X-Q. 91. Now, by the way of comparison, Mr. Atwater, would you kindly state the difference between the recovery upon the first commercial operations that you conducted and the recovery that you are effecting in your own plant at Basin? Do I make myself clear?

A. Not quite.

X-Q. 92. Assuming that you are making a recovery of 80 per cent of the mineral content while conducting your first commercial operation with flotation, what would have been the relative recovery, or the comparative recovery with the operation that you conducted at Basin? Would it have been higher or lower?

A. I don't understand you now.

X-Q. 93. Were you making a greater recovery then at Basin—a greater recovery at Basin than you were making when you were conducting your first commercial operations?

A. Yes, a greater recovery.

X-Q. 94. How much greater? That is what I want to get at.

A. Why, we are making.

X-Q. 95. Approximately?

A. Ten or fifteen per cent greater.

X-Q. 96. Then if under the assumption that I have made, if your recovery upon your first commercial operation had been ~~80~~⁸⁰, why the recovery upon the more refined operation would be 90?

A. Yes, take it that way.

X-Q. 97. What is that due to, Mr. Atwater? The

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advancements made in the operation, the knowledge gained and the experience that has been derived from the constant use of the flotation process, studying the factors?

A. I think it was mostly due to following the advice of Minerals Separation experts.

X-Q. 98. Whose advice did you follow?

A. T. M. Owens' advice.

X-Q. 99. Was there any marked change in the operations since you have known them?

A. Yes, there was quite a different process.

X-Q. 100. What was that change?

A. You mean what was the change that Owen advised me to put in?

X-Q. 101. Yes.

A. Stop the use of oleic acid, change to pine oils, reduce the amount of oil considerably and increase the amount of acid.

X-Q. 102. Well, how much did you reduce your oil?

A. Reduced our oil four pounds a ton, when we changed from oleic to pine oils.

X-Q. 103. That was due entirely to the character of the oil—that is the character of the oil?

A. I think so, yes. I do not think we could have used six pounds of pine oil successfully even the way we were working then.

X-Q. 104. Did you ever try it?

A. I have seen the machine ^{over}oiled when it might contain six pounds of pine oil.

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X-Q. 105. You don't know what it did contain?

A. No, we didn't measure it.

X-Q. 106. How about machines?

A. When I started our flotation operations at Basin we purchased what is known as standard Minerals Separation machine, and we didn't change that when we changed the oils and acids.

X-Q. 107. And you are still using that so-called standard Minerals Separation machine?

A. Yes, sir.

X-Q. 108. Did Owen recommend any other machine?

A. He did not.

X-Q. 109. Do you recognize any distinction or difference between the standard Minerals Separation flotation machine and a sub-aerated machine?

A. Why certainly I recognize a difference.

X-Q. 110. Aren't you using a sub-aerated machine?

A. We are using one now, yes.

X-Q. 111. Upon whose advice did you adopt that?

A. That was put in on our own—

X-Q. 112. And you have not entirely confined your operations to the direction and advice of Mr. Owen or the Minerals Separation, have you?

A. Not entirely, no.

X-Q. 113. And aside from advising you to change the amount of oil and to change from the use of oleic acid to pine oil, what other changes did Mr. Owen recommend to you?

P. 4145, L. 23, insert "Did you know that before Mr.
Owen told you. A." after "119."

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A. Why, he recommended—he worked in the plant for quite a while and during that time he experimented in many ways with dilutions of feed, with fineness of grinding, with various treatments.

X-Q. 114. Just confine yourself to the recommendations that he made, Mr. Atwater, as to the things that you adopted. I asked you what he recommended?

A. Why, there were many small mechanical details in the mill. The principal recommendations that he made are those that I have already mentioned.

X-Q. 115. Well, at that time had you not information that pine oil was being used elsewhere?

A. Yes.

X-Q. 116. Where was it being used, if you know?

A. I think they were using pine oil at that time at the Timber Butte mill in Butte.

X-Q. 117. What time was that?

A. This was in 1914.

X-Q. 118. Don't you know that they were using pine oil at the Butte & Superior at that time?

A. I was about to add at the Butte & Superior?

X-Q. 119. I believe I did; I don't know whether I knew it before; we were all changing our oils—the various flotation plants were changing their oils pretty rapidly at that time, experimenting.

X-Q. 120. Then Mr. Owen did not tell you anything that was not generally known, did he; that is, about the desirability of changing from oleic acid to pine oil?

A. No, I suppose not.

X-Q. 121. Now, the, what did he tell you that was

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not generally known, or which you did not know before, in connection with the process?

A. I think the value of his services to me was mainly in his definite knowledge and his definite statements and recommendation in putting into operation—

X-Q. 122. I don't like to interrupt you, because we usually get along faster if I don't; but please answer the question; what did he tell you that you did not know and that was not generally known?

A. I am not responsible for general knowledge. If you ask me what I know I will tell you.

X-Q. 123. What did he tell you that you did not know then?

A. He told me to use less oil, and the kind of oil to use, and more acid and more heat, and I did not know that those were the proper things to do until he told me so.

X-Q. 124. You had used heat before?

A. We had used heat before.

X-Q. 125. What temperature?

A. We ran the machine at about 100° F., I believe.

X-Q. 126. The centigrade scale has been used throughout the testimony, so would you reduce that to degrees centigrade?

A. Yes; about 40° C.

X-Q. 127. Had you ever operated before at 40° C.?

A. We were operating then at 40. He raised the temperature above 40.

X-Q. 128. To what?

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A. 50 or 55° C.

X-Q. 129. Had you ever operated before at 55° C.?

A. Probably; certainly not steadily.

X-Q. 130. Didn't you operate the Butte & Superior plant at 55 to 60° C.?

A. No, I don't think we operated the Butte & Superior plant as high as we operated the Basin plant which we put in.

X-Q. 131. Well, Mr. Atwater, from your experience in flotation, do you or do you not subscribe to this general statement, that every ore—and in that I embrace tailings of course.

A. Yes.

X-Q. 132. Every ~~ore~~^{one} furnishes its own flotation problem?

A. Yes, I subscribe to that general statement.

X-Q. 133. Then the changes and variations which are made in operation are largely due to the character of the product being treated; is that not true?

A. That is true.

X-Q. 134. So, where a greater degree of heat, a larger amount of oil, a larger amount of acid, if acid is used—a greater degree of agitation, a greater degree of dilution, all are factors that enter into flotation operations as you endeavored to apply them to different products, isn't that true?

A. Yes, that is true.

X-Q. 135. What is the percentage of iron and insoluble in your present concentrates. your copper concentrate; I only mean approximately, of course.

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A. The iron runs about 10% and the insoluble runs 15 or 20%; that will do for an approximation.

X-Q. 136. What is the per cent of iron?

A. About 10% I said, and 15 or 20% insoluble.

X-Q. 137. What is the balance of your hundred per cent?

A. Well, we have the copper and the silver.

X-Q. 138. You have 9% copper?

A. Well, add it up there; there is 9% copper; add the silver to that, and then add the 10% of iron, and we have a little lead—1% of lead, no, there is very little lead. The rest would be insoluble, or very nearly so; it would make about 40, wouldn't it?

X-Q. 139. Do you desire now to say that your insoluble is 45 rather than 15?

A. Yes, I think that is closer to it.

X-Q. 140. Now, these copper concentrates that were made from the tailings deposited during the old Heinze operations, at Basin reduction works, extending over a period of a number of years prior to 1910?

A. Yes.

X-Q. 141. What is your ratio of concentration in the treating of those tailings?

A. About eight or nine tons of ore into one of concentrate.

X-Q. 142. Running 9% copper, the concentrate, of course?

A. Yes.

X-Q. 143. What is the copper assay of the heads into your flotation machine?

P. 4149, After L. 2, insert “ x-Q. 144. And the tails ? ”

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A. About 1.25% copper.

A. The tails run around .2 when the machine is operating well.

X-Q. 145. What does it run when it is not operating well?

A. About .4 or .5.

X-Q. 146. What else do you find in those tailings; what other metal?

A. Silver, and a little bit of gold; silver is the only thing that amounts to anything in value.

X-Q. 147. You stated that you were using a sub-aeration machine; I more properly should have asked this a while ago when we were discussing your plant. Was that sub-aeration machine in existence in 1910 or was there such a machine in existence in 1910—to your knowledge, of course?

A. Not to my knowledge.

X-Q. 148. Now, Mr. Atwater, regarding this estimate that you made of a million dollars excess profits between the time that the Basin mill started on wet concentration and the time when flotation was adopted, what recovery do you assume in your wet concentration upon the Butte & Superior ore?

A. When I made that computation I believe I used 55% recovery; between 55 and 60% I must have used.

X-Q. 149. You would not assume 65 or 70?

A. I did not assume 65 to 75, no.

X-Q. 150. Would you do that from your knowledge of that ore?

A. I would not.

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X-Q. 151. When you say you would not assume 65 to 70% recovery, have you in mind the plant in which you were operating?

A. Yes.

X-Q. 152. Is that one of the factors?

A. Yes, indeed.

X-Q. 153. By that you mean that the Basin plant was not well adapted to milling—to successful milling, do you not?

A. Yes.

X-Q. 154. Well, how would that have affected the increased recovery in flotation, if the Basin plant was wasteful? How would that affect the additional recovery by flotation?

A. Well, the best we ever did in the way of recoveries at the Basin plant by wet concentration for a month's average, was 60% I believe; 60 or very close to that.

A. Yes.

X-Q. 156. The mill was all out of alignment?

A. Yes.

X-Q. 157. The launders were right against the ground, underneath the floors, causing a constant overflow and flooding of the mill, was it not?

A. The mill was in very bad condition.

X-Q. 158. The elevators were in very bad condition, constantly breaking and overflowing and not performing their functions, were they not?

A. That is true.

X-Q. 159. It was impossible to place—I wouldn't

P. 4150, After L. 19, insert "x-Q. 155. You know why you did not make a better recovery?"

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say it was impossible, but it was practically impossible to place your tables upon a level base for successful table operations, was it not?

A. Yes.

X-Q. 160. The mill was sloping down hill, was it not?

A. Yes, it was actively sloping down hill.

X-Q. 161. It was a very bad mill, was it not?

A. A very bad mill.

X-Q. 162. Do you think that had anything to do with the fact that there was 14 per cent zinc contained in the tailings?

A. Yes.

X-Q. 163. Now in addition to the tailings that you found there as a result of Butte & Superior operations were there any other tailings deposited there?

A. No.

X-Q. 164. Don't you know, Mr. Atwater, that there was the—that during the Heinze operations that a large tonnage of zinc ore from the La France mine or the Lexington mine of the La France Company had been milled in that plant at Basin?

A. I know that they had a mill running there of a few hundred tons—I would call it a few hundred tons, not a large tonnage.

X-Q. 165. You state that as a matter of knowledge or as a matter of impression, Mr. Atwater—I better ask you this way: Do you know whether or not the Basin Reduction Company or the La France Company operated that mill upon Lexington ores over a con-

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siderable period of time constantly, meaning many months.

A. You mean while we were operating there?

X-Q. 166. No, I mean before?

A. No, I do not know.

X-Q. 167. Now, during the time that the Butte & Superior was operating at the Basin mill or at least during a part of the time the Butte & Superior was operating at the Basin mill, the mill was divided into two units, was it not?

A. Yes.

X-Q. 168. Butte & Superior using one unit and the La France or Basin Reduction Company using the other?

A. The La France Copper Company reserved the right to use the other half.

X-Q. 169. And they did do that, did they not?

A. For a short time.

X-Q. 170. Can you tell how long a time?

A. No, I can't tell you that.

X-Q. 171. Can you tell us what tonnage of zinc ore from the Lexington mine they treated there?

A. No, I can't tell you that. I was under the impression it was a few hundred tons while we were there.

X-Q. 172. Then I will ask you one general question to cover all of that: Can you tell us the recovery that they made; the percentage of zinc in their tailings; or approximately the number of tons of tailings deposited by the La France operations?

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A. I cannot.

X-Q. 173. Or anyone of those facts?

A. None of them.

X-Q. 174. Now, in estimating the profits which you say might have accrued to the Butte & Superior, what allowance for interest and amortization on the original investment did you make?

A. I made no allowance whatever.

X-Q. 175. How did you calculate the amortization on the hypothetical flotation plant?

A. I had the figures, costs and returns, of expenses that went to the Butte & Superior operations in Butte and Basin. I had those at the time and I added to them the cost of treating the tailings, which I had treated myself there. I knew the cost per ton of treating those tailings. I added ~~the~~ ~~I added~~ to the concentrate ^{returns} ~~reports~~ the extra recovery they would have made, and as I remember these computations, the difference was over a million dollars.

X-Q. 176. Now, Mr. Atwater, can you furnish us with a table which you used?

A. What table?

X-Q. 177. The table that you used in getting up these figures? A table showing all of the facts that you considered in arriving at this one million dollar increased profits?

A. The table of costs for the Butte & Superior operations or the table of my computations?

X-Q. 178. The table of your computation?

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A. No, I cannot. I made those computations some years ago.

X-Q. 179. Well, surely, Mr. Atwater—

A. (Interrupting.) I haven't got those papers.

X-Q. 180. Can't you do it for us now; can't you make up a table?

A. While I am sitting here?

X-Q. 181. Oh, no, no, not while you sit there.

A. Why, certainly, yes.

X-Q. 182. When will you do that?

A. I will do that as soon as I am able, I will today or tomorrow.

X-Q. 183. Will you do that and furnish it to us?

A. With pleasure.

X-Q. 184. Did you add to the cost of concentrating equipments and operations to keep the tailings out of the creek at Basin? Do you recall that now offhand, whether you did or not?

A. Oh, no, I didn't add that. There was no cost to that.

X-Q. 185. Did you add the cost of installing—of installation for finer grinding?

A. Certainly.

X-Q. 186. You did?

A. Certainly.

X-Q. 187. Finer grinding would have been necessary?

A. Yes.

X-Q. 188. How many mills did you allow for?

A. I didn't allow for any number of mills. I mere-

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ly took the cost of our own operations at Basin. By our own operations, I mean the operations in our present flotation plant.

X-Q. 189. All of these things of course that you took into consideration will be shown upon the table that you are going to furnish us, isn't that true?

A. I will show you the way I arrive at my figures, at my results.

X-Q. 190. Now, practically all of this—what proportion I will ask you of the fifty to sixty thousand tons of tailings were produced before flotation was installed at Basin, if you know, Mr. Atwater?

A. You mean before we put the Hyde plant in at Basin?

X-Q. 191. Before Mr. Hyde put the Hyde plant in at Basin, yes.

A. About half of that amount—I am guessing at that; I can't tell it accurately without the record.

X-Q. 192. Mr. Atwater, do you remember a visit made by Mr. Dosenbach and Mr. Wickes to your mill just after you had started operations?

MR. WILLIAMS: Unless the intent of the testimony is to in some way bear upon the direct examination, it seems to me that that is unwarranted.

MR. KREMER: It is or I wouldn't have asked it.

THE COURT: We will see what he comes to.

X-Q. 193. MR. KREMER: Do you know?

A. Yes, I remember a visit by Mr. Dosenbach and Mr. Wickes.

X-Q. 194. After you had been operating a couple of months approximately?

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A. Yes, I think so.

X-Q. 195. You were using six to ten pounds of oleic acid then, were you not?

A. We were using all of six pounds, yes. We might have been using ten pounds.

X-Q. 196. And Mr. Owen visited your plant at that time?

A. I think later.

X-Q. 197. After that?

A. I think later.

X-Q. 198. Didn't they tell you at that time to use pine oil with the oleic acid.

A. I don't remember their telling me to use pine oil with oleic acid, no.

X-Q. 199. Do you remember telling anyone at your plant?

A. I do not, no. I don't remember that.

X-Q. 200. Was it communicated to you that they had told any one of your employees?

A. I do not remember.

X-Q. 201. What was the circumstances if any of the comment about pine oil during that visit?

A. I know of no comment on pine oil during that visit.

X-Q. 202. And will you state that they did not tell you to use pine oil with the oleic acid?

A. I will not state so.

X-Q. 203. You will only say that you do not remember?

A. That is all I can say.

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X-Q. 204. You certainly would have remembered it, Mr. Atwater, would you not?

A. If they told me so then I don't remember, Mr. Kremer.

X-Q. 205. All right. Mr. Atwater, did you ever see the flotation process practiced in an operation provided with three spitzkastens, such as is shown by the diagram accompanying the patent in suit, 835,120? Did you, Mr. Atwater?

A. I don't remember such a machine.

X-Q. 206. Being as interested as you are in flotation, you probably would have remembered if you had ever seen it, would you not?

A. I think if I saw a machine like that running and treating ores that I would remember it, yes.

X-Q. 207. Did you ever see one that was not running and treating ores?

A. You mean a full sized machine built to treat commercial ores?

X-Q. 208. Yes.

A. I think I would remember having seen that machine.

X-Q. 209. But you never did?

A. No.

X-Q. 210. Did you ever see a flotation process practiced with up currents of water in the spitzkasten as shown in patent 835,120?

A. You are referring to this machine? I haven't read the description of it. It is rather hard to read some of these pictures.

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X-Q. 211. Can't you read the picture?

A. It shows no current.

X-Q. 212. What?

A. You mean there are up currents of water designated here?

X-Q. 213. What are these?

A. I don't remember seeing such a machine with up currents of water, no.

X-Q. 214. You would remember, would you not, if you had seen it?

A. I don't know.

X-Q. 215. Have you ever seen the flotation plant practiced with the cone Gabbett?

A. On a commercial scale?

X-Q. 216. Yes.

A. No.

X-Q. 217. Have you seen it in experiments performed?

A. Yes.

X-Q. 218. In the court room and in laboratories?

A. Yes.

X-Q. 219. Have you ever seen the flotation process practiced in an apparatus in which the pulp after agitation flowed over an open apron such as is shown by the diagram accompanying patent, 835,120?

A. No, I never saw any operation carried on with that machine.

X-Q. 220. Do you think it practicable to use such a machine as I have described, in commercial operations?

A. Why, I think it is practicable, yes.

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X-Q. 221. Why haven't you done it?

A. Perhaps I never thought of doing it.

X-Q. 222. You have seen that picture many times, haven't you?

A. I never studied that picture.

MR. KREMER: That is all.

RE-DIRECT EXAMINATION.

BY MR. WILLIAMS:

R-Q. 223. You have mentioned Mr. T. M. Owen?

A. Yes.

R-Q. 224. What was his position in connection with Minerals Separation Limited?

A. He was one of their field experts at that time he made the recommendation I spoke about.

R-Q. 225. And was he sent to you by Minerals Separation?

A. Yes, he was.

R-Q. 226. I didn't ask you the extent of the dump of the Heinze copper dumps that you are now treating. What was the amount of these dumps at the time you started operations?

A. Between—about sixty thousand tons, maybe eighty thousand tons. They are very difficult to measure as they lie.

R-Q. 227. There was something said about some other dumps—you live at Basin, don't you?

A. I live at Basin.

R-Q. 228. You know pretty nearly what dumps are there, don't you?

William Mason Grosvenor.

A. Yes, I ought to know.

R-Q. 229. If there were any other dumps there you would probably know it, wouldn't you?

A. Yes, indeed.

MR. WILLIAMS: That is all.

WILLIAM MASON GROSVENOR, called as a witness in behalf of the plaintiff in rebuttal, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. WILLIAMS:

Q. 1. State your name and residence?

A. William Mason Grosvenor; 125 West 58th street, New York City.

Q. 2. What are your qualifications as to scientific matters involved in the process of froth flotation concentration of ores?

A. My under-graduate training was obtained at the Polytechnic Institute at Brooklyn, where I pursued both the chemical and engineering courses for five years, and received the degree of Bachelor of Science. As a matter of fact I was interested in physics and chemistry a great many years before I went to college and was experimenting with them.

After graduating I returned there as Dr. Peter Austin's assistant and did teaching work for a year. Dr. Austin advised me not to continue teaching work but to pursue my course and I went to John Hopkins

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University, where I took the major courses in chemistry with physics and mathematics as minors, the chemical work being under Dr. Remsen, the physics and mathematics both under Roland and Ames. The physics and mathematical work was completed the first year and it then became necessary for me to do some practical work, interrupt my education. I went west for some New York people—came west to investigate the iron ore and gold and silver ore mining and treatment, the iron in Michigan and Minnesota and the gold and silver in Cripple Creek and some other points in Colorado. After that I became chief chemist of the Costner Electrolytic Alkali Plant in Saltville, Virginia, where I became especially interested in electro-chemical work and was then able to pursue my educational work, so that I went to the University of Pennsylvania to get the electro-chemical work under Professor Smith. There I also had physical chemistry under Professor Harden and physics under Dr. Barker.

Since leaving the University practically all of my time has been devoted to technical work.

Q. 3. Did you refer to the fact of any degree received at the University of Pennsylvania?

A. I failed to mention that I received the degree of Doctor of Philosophy in 1898.

Since leaving the university my work has been almost exclusively the study and investigation of industrial processes and the principles on which they depend, generally with a view to improving their commercial operations, and occasionally with a view to

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patent distinction or characterization. The first work that I did was the investigation of the electrolytic gold extraction process, which never became practical. The theory was all right, there was plenty of theory, but it was one of those cases of an invention that fails because of some perhaps perfectly obvious practical point that had been overlooked because no one happened to think of it. Then I undertook work for the Ampere Electro-Chemical Company, a corporation organized to do inventing and developing work in scientific lines. With that were associated C. S. Bradley, men like Prof. Pupin, of Columbia University; Messrs. Crocker & Wheeler, of Crocker, Wheeler & Co., and Cooper Hewitt. In 1900 I went to the General Chemical Company as ^{assistant} general superintendent of ~~the~~ plants manufacturing chemicals, and two years later to the investigation department of that company, where the work was the examination and investigation of means of improving our own processes, and also of new processes brought in for the consideration of the company. I then became superintendent of the Contact Process Company of Buffalo, which had purchased and was in the process of installing a number of new processes from Germany, and was compelled to do a good deal of studying of new methods. ^{There} After that some work was done in the design and construction of conveying and handling machinery as a contractor, and in that work I came in contact with a number of technical and mechanical problems in the new industries that were being installed at Niagara Falls. From 1907 to date

William Mason Grosvenor.

I have been engaged in consulting practice in New York City, and my work has brought me in fairly intimate contact with a number of colloids, such as glue, leather, paper and celluloid.

Q. 4. When did you commence to give any study to the subject of the flotation concentration of ores?

A. About the beginning of 1914, when I undertook for Minerals Separation, Limited, a study of the process^s, the literature, and the principles—particularly the principles upon which the process relied, as far as could be ascertained.

Q. 5. And in the suit of Minerals Separation Limited, against Miami Copper Company, which was tried at Wilmington, Delaware, did you give any testimony and do any work in connection with that suit?

A. I did a great deal of work in the preparation for the suit, and made a great many hundred tests, and photographed a number of them, using the moving picture method of photography, and testified during the trial, and presented the pictures of what happened under given conditions with given materials.

Q. 6. Were those pictures exhibited to Judge Bradford?

A. They were.

Q. 7. And put in evidence in that case?

A. They were.

Q. 8. And were they exhibited to the Circuit Court of Appeals of the Third District at Philadelphia during the argument of the appeal?

A. They were.

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Q. 9. In the course of your study of flotation have you examined the operations of the mills that were operating the process?

A. At the Miami mill, at Inspiration—where I had of course more opportunity to discuss the processes with men who were working it—and at Anaconda; also at the Butte & Superior.

Q. 10. Now, the—before going into a consideration of the phenomena, will you define the terms of the art, insofar as you propose to use them?

A. In order to avoid confusion, I will try to use mineral and gangue in the sense that by mineral I mean sulphide or similar non-wetting portion of the ore, including sometimes metal; and by gangue, the silicious or other portions of the ore not mineral.

By oil I mean the undissolved portions of the liquid, or easily liquified organic bodies, having a preference for wetting minerals as compared to gangue. I do not mean vinegar or acetic acid of any strength, or alcohol, or dissolved phenol; that is, I do not mean to refer to them as oils.

By frothing agent, or mineral frothing agent, I mean a body capable of producing a highly mineralized froth by the addition of it alone to a properly aerated and agitated pulp. An oil may be a mineral frothing agent. A soluble frothing agent is one which is dissolved in the water of the ore pulp.

When I speak of selection and selectivity, I mean the act or power respectively of attaching to one body rather than to another.

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By affinity and attraction I mean the tendency of one thing to attach itself to another (without going into the question of whether the reasons are physical or chemical) and to remain thus attached, or by preference in close proximity.

When I speak of a film or layer, I mean to try to make some distinction between the two, because a film is a thin layer, and while it is true *that no major limit can perhaps be set to the thickness of a film*, I should regard it as absurd to speak of an oil film or *adsorption layer* anything like 1/100 of an inch thick.

Now, in regard to adsorption, I think the use of that word should be limited to the increased concentration of a dispersoid within the adsorption medium at the boundary of the medium, a strictly surface effect. Now, a dispersoid is anything that is dispersed, like salt dissolved in water, or colloidal slimes, so-called, suspended in water, and the water in that case is called the dispersion medium, the thing in which the dispersoid is dispersed. That was the definition I prefer of adsorption, the drawing together or concentration of this dispersed material at the face (the limiting face) of this dispersion medium—the meaning which Van ~~Bummen~~ ^{Bummen}, the originator of the term, preferred to give it. However, the defendant's scientific experts have used the word adsorption in its far more general sense, meaning the unequal distribution of the substance at the boundary between two phases, and I think it would be wiser to have that meaning for the discussion. For instance, we speak of two phases,

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water and air where they meet. We speak of those as a liquid phase and a gaseous phase, and it is in that, at the interface, that the water is forming a layer increasingly dense as it approaches that face, and increasingly heavy (that is, in the sense of specific gravity) and the air, as it approaches that interface is increasingly condensed and will form a very, very thin layer thereat.

I want to avoid the sort of confusion which seems to me ^{may} ~~to~~ arise if we do not stay with one definition or the other. Professor Taggart, when asked if there was not an adsorption layer at the oil-water face (Diagram 7, exhibit 130, Q. 142 and 143), answered: "Adsorption of What?" and went on to say, "I don't know of any particular adsorption there that is of any importance in the discussion. It is possible, it is true, that if there is present in either the oil or the water, any contaminant, there will be adsorption of that contaminant at that interface, but I do not know of any such contaminant in the flotation process." For instance, there he seemed to use the a Van ^{Bemmelen} ~~Bemmelen~~ definition. In answer to question No. 146 he has changed his thought, or the idea is changed, and he said: "There is a layer of regularly varying concentration, from all oil, less and less and less oil, to all water." In question No. 147: "Unquestionably that would be an adsorption layer." Page 904.

Prof. Bancroft has refused to regard the surface film of water varying in density where it met any limitation—where it met air—as an adsorption layer; in fact he quite scouted the idea, although he defines ad-

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sorption himself, as: "Adsorption is surface condensation, or concentration," and there would be condensation—concentration in the condensation at that layer.

Also it has been said in testimony that particles of mineral .005 ~~millimeters~~^{inches} in diameter are adsorbed into an interfacial film. The precise dimensions are not given, but they were spoken of as the mineral used in flotation, and that is one of the intermediate sizes of particles. That ^{was} also stated in connection with the testimony in regard to Diagram No. 7 by Prof. Taggart, question 141, and was adopted by Prof. Beach, question 157, page 1014, concerning which we are told that the film may be 100 molecules thick. Prof. Beach, question 152, page 1012, "that would be somewhere in the neighborhood of four millionths of an inch." That illustrates one view of the adsorption layer, while Professor Bancroft would have us regard as an adsorption layer any thickness of oil whatever, or of any adhesive material, that will hang onto mineral or to metal; questions 160 and 161, page 1131. He might regard the butter, no matter how thick the layer was, on the small boy's bread, as being adsorbed. By adsorption, therefore, I shall try to confine myself to the film which is held to the mineral by the range of forces ~~which by~~^{and} ~~the range of forces~~ at the interface exclusively, I shall regard as coherent ~~with~~ the additional oil or material which sticks to that film. I think there is a difference and an important difference between those two.

By bubble I do not mean merely the air in the bubble or the outside skin or surface, which may be some hun-

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dred thousandths of an inch thick, or the adsorbed film of acetic acid on the outside of that interface, which may be a few hundred thousandths of an inch thick, or the layer of oil which I should call film of oil, on the inside, which may be a few hundred thousandths thick, or the adsorption film between that oil and the air, but I mean the whole bubble, as it moves through the pulp, including everything that functions as a bubble proper. That is a natural definition and its importance becomes considerable as we go into the matter.

By attachment, either indirect or direct, and possibly very intimate between the air and the mineral, I do not limit the kind of attachment to surface tension or electrostatics, or any other cause or method of attachment, but when I speak of direct attachment I mean the direct attachment of that mineral particle to the air bubble, which is intimate and physically immediate, holding the two together as a whole, with whatever adsorption layers there may be on the surface, either of mineral particle or of the bubble as a whole. Where something comes between the mineral and the air, with a practical, substantial, effective action to separate them in space, and materially affects their inter-action, for the purposes in mind I would call the attachment then an indirect attachment.

Professor Taggart himself, quite naturally and unconsciously makes the same distinction and the same definition, when he overlooks the theoretical side on page 912, question 177: "Q. And where is the min-

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eral, the metalliferous mineral product? A. "The mineral is wholly within the bubble, the film." Then he goes on to emphasize that, not as a theory but as an observation of fact: This ^{is} direct attachment to the bubble—

Also Prof. Beach, in the answer to question 36, where he refers to "this adsorption layer, from which bubbles may be constructed, and by its adhesion to the particles they are separated from the gangue."

To illustrate this point, I want to submit a set of diagrams, of which No. 1—(I have not numbered these, Mr. Williams, and I am sorry to say we have no reproductions of them)—shows much enlarged what I have many times seen to be the position of the unoled mineral when attached to the unoled air bubble in distilled water.

No. 2 similarly represents the mineral particles when minutely oiled and attached to ^a minutely oiled bubble.

No. 3 similarly represents a mineral particle carrying perhaps a third of its own volume of oil, 8 per cent by weight in the case of galena, and attached to the oiled air bubble.

No. 4 similarly represents a mineral particle either having slightly more oil or attached to an oiled bubble that is moving or straining at the oil connection. This last condition I have called indirect attachment or linking of the mineral to the bubble by an oil neck, and the first and second conditions I call direct attachment of the bubbles, What the third condition may be ^{is} independent upon circumstances, the character of oil, the kind

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of agitation, the amount of oil, the shape and fineness of the mineral particles; but it is obvious mechanically that for every set of working conditions there lies between No. 2 and No. 4 a condition whereat the attachment ceases to be substantially direct to the bubble itself, as a whole, and is accomplished only by a weak neck of oil. Prof. Bancroft correctly described this in his answer to questions 118 and 119 on pages 1109 and 1110, and correctly made his statement regarding what would happen when too much oil or too heavy a particle was used, that is, too much pull on the indirect attachment link. He says:

“The oil would neck off and the particle would not be lifted.”

Now, this neck of oil or an amount of oil which under working conditions permits the formation of such a neck, I regard as a means of indirect attachment between the mineral and the pulp. Such oil is not a proper part of the bubble because it does not contribute in any way to the proper functioning of the bubble, nor is it a proper part of the oiled mineral because it interferes with the natural behavior of the mineral particle. Instead of promoting the function of either bubble or mineral particle for the purposes in hand, it is simply a mass of oil within which the particle of mineral has been entrapped at one point and within which the bubble of air has been entrapped at another point. Each of them is beyond the influence of the forces of the other. That, I think, should make perfectly clear what I mean and have meant by the strong direct attachment

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of mineral to an air bubble or, more briefly, to air in the presence of a frothing agent. I may sometimes speak of the attachment or the affinity of air for mineral when minutely oiled in another sense. In my opinion it is quite possible that there should be such attachment directly through an oil layer, if the oil layer is sufficiently thin, though it is obviously not necessary or essential to the success of the air froth process, so far as we can see today. I mentioned it here because it will serve to clear up a good many uncertainties with regard to the relative thicknesses of these films of one kind or another.

Quincke assigns a range of molecular action as about two millionths of an inch; Plateau reached a value of five millionths by the limiting thickness of glycerine films; Park⁵, by the wetting of powders reached a value of six millionths, this being their determination of the so-called range of molecular action, which means the reaching out of the forces which we understand causes concentration at surfaces. Now, Lewis, in 1910, concluded as the result of many experiments on adsorption at the oil-water interface, that the adsorption films, in the case of one of the least actively adsorbed material, was about six millionths of an inch.

Devaux, in 1912, proved that the maximum thickness of certain oil films on water or mercury (which I regard as comparable with our minerals or metals) before globules began to form, exhibiting the action of oil in bulk, was six one hundred millionths of an inch and that these films became stable against the thicken-

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ing action of lenses or of an excess of oil when the films reached a thickness of about twelve one hundred millionths, even though there is more oil than required to make up that particular layer and enough to build up and form either globules or lenses on the surface of this layer. The layer remained stable against these. It was shown that the rest of this film would not increase beyond about ten millionths of an inch. Now, we have therefore the minimum oil layer, according to Professor Bancroft, about one ~~one hundred~~ millionth of an inch, somewhere in that general range. The maximum about six, on top of which or around in which there may be respectively globules or lenses, and if these lenses are present then the layer becomes slightly thicker and we have one, the layer which is stable against lenses.

It is simply^e to use one hundred millionths of an inch, which we will regard as the unit, and simply taking the number of one hundred millionths concerned only. In passing it might be well to emphasize the fact that the one hundred millionth is a pretty small unit for flotation or for mineral particles that are used in flotation.

Now, the range of molecular action or the reaching out of one kind of matter to affect another, the reaching out of one unit of matter to affect the mass of matter itself, has been stated by Quincke as two hundred, Plateau as five hundred, Parks as six hundred, Lewis (in the sense of the adsorption layer at the oil-water interface) as six hundred, and by Professor

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Taggart, if I recollect, about two hundred. We have for comparison then those ranges—from one to ten, and from two hundred to six hundred, the one to ten being the thickness of an obstructing oil layer; the two hundred to six hundred being the range of molecular action of the mineral to reach through oil and affect other air on the other side.

I believe, therefore, that I am justified in thinking that two hundred ~~hundred~~ millionths range of molecular action or six hundred ~~hundred~~ millionths range of molecular action can easily reach through an oiled film which is only one twentieth or one sixtieth of that thickness. This will be particularly true if it is admitted that one side of the oil film is partially mixed with air and the other side of the oil film is partially mixed with mineral.

MR. WILLIAMS: I now offer in evidence the diagram referred to by the witness, diagram number 1 as plaintiff's exhibit 237.

Diagram admitted in evidence and marked ~~DEFENDANT'S~~ EXHIBIT 237. *Plaintiff's*

MR. WILLIAMS: I now offer diagram number 2 as plaintiff's exhibit 238.

Diagram number 2 admitted in evidence and marked PLAINTIFF'S EXHIBIT 238.

MR. WILLIAMS: Diagram number 3 as plaintiff's exhibit 239.

Diagram number 3 admitted in evidence and marked PLAINTIFF'S EXHIBIT 239.

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MR. WILLIAMS: Diagram number 4 as plaintiff's exhibit 240.

Diagram number 4 admitted in evidence and marked PLAINTIFF'S EXHIBIT 240.

THE WITNESS: Now, illustrating the importance of the thickness of the stable layer which we have stated as having been determined by Devaux ^t about ten one hundred millionths of an inch, and the importance of the fact that ~~that~~ it is stable against the presence of lenses or nodules of oil. Suppose we have a part of the film of the bubble which we will draw of a minute thickness, as compared with the diameter of the bubble. We will call the lower portion of the diagram "W" beneath the film, the water; "O" the oil and "A" the air above that film. Now, certainly in level films we find that when that ~~layer~~ ^{film} is thickened beyond ten one hundred millionths, nodules gather. I have observed the phenomena, but can claim no credit for having determined it or having discovered it. If the film is contracted the little nodules bristle upon it. In some cases it occurs rather as a thickening of the layer, one side or both sides. One such nodule we will mark "N," and the lens "L." The presence of such nodules or lenses does not interfere with the importance of the general statement of dimensions that we have made because the film of ten one hundred millionths is in many cases at any rate stabilized against the present^{or} of these nodules or lenses.

MR. WILLIAMS: The diagram made by the wit-

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ness is marked diagram number 5, and I will offer it in evidence as exhibit 241.

Diagram number 5 admitted in evidence and marked PLAINTIFF'S EXHIBIT 241.

A. (Continuing.) Before proceeding with a detailed discussion of the phenomena which may be regarded as essential or vital to flotation, it will be well to familiarize ourselves a little with the materials being used for testing and examining these phenomena, and to remember that we are not attempting to pursue any industrial result, but to examine into certain principles, general basic principles, as explained by the character of materials that enter into flotation. It will be equally profitless to theorize about that on the one hand or to try to analytically consider a given flotation operation going on with the whirl of material on the other. If we desire to measure the effects and eliminate guesswork we must make a quantitative analytical comparison of the forces involved. And in order to do that, we must use mineral particles which are large enough to test to the limit the forces that we wish to examine so that we may quantitatively measure the ability of these forces to overcome strains like the jerks and twists which the particles must undergo during agitation. For this purpose we may use galena particles carefully selected—carefully selected because we want them cubical as nearly as possible or carefully measured so as to ascertain the periphery or length of the line around the top where attachment is likely to take place, or the medial line where attachment seems

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to take place and frequently the particles stick clear up into the bubble. And we may go further, where we want readily comparable quantitative results, satisfying ~~to~~ ourselves that the galena particles attach to air bubbles in the same way that aluminum particles do; that aluminum particles exhibit the same degree substantially of attachment when they are clean. By "clean" I mean carefully cleaned in the sense which Professor Beach so well described—because the slightest trace of oil acts as a changing or modifying material, ~~and~~ If we take particles of a fixed diameter and vary their thickness, we secure a sort of scale of weights which we can use in examining the phenomena. In making these comparisons, and in particularly in making the photographs it is important to use perfectly plain plate glass vessels or faces through which to photograph, so that there may be no distortion. And it is also important in some instances to use a bottom for special purposes, (You might call it a false bottom), which will not wet with oil and which will therefore enable us to use oiled particles without fear of their attachment to the bottom of the vessel. The galena particles are selected and weighed. Their size is illustrated by ~~the~~ ^{these} three particles, six, sixteen and twenty milligrams, which have been used for some of the work, that being a six milligram particle, this second one sixteen and the third a twenty milligram. I give these weights roundly at the nearest unit because a variation in the particles and a variation in the accuracy of the face of the particle is greater than makes it

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necessary to give weight to decimal place. For purposes of comparison, for accurate calculation I used a set of aluminum punchings varying in thickness but not in diameter. $5/32''$ was chosen as a convenient diameter and the thickness used gave nine milligrams weight for the thinnest, 17, 28, 35, 42, 54, 64, 75, 89, 98 and 104 milligrams ^{are} the consecutive weights of the particles used. To illustrate some processes, particularly to make grossly visible the oil neck and the action of oil and water when mineral is passing through the interface between the two, I have used a large aluminum particle about an inch in diameter which can be floated, when clean, but which for this purpose (passing through the interface) must be suspended by threads that are exceedingly thin.

We shall illustrate some of these simple manipulations, by lifting the metallic and mineral particles. 104 milligrams of the standard set is the largest that I have yet been able to lift—but, owing to the present conditions and the difficulty of getting them perfectly clean, it will be illustrated with a lighter particle. We will then apply small or large quantities of oil to the particles and try to lift them, and then illustrate the effect of moving the bubbles so that we may roughly compare their lifting or attaching power with that of what has been called the captive bubble. Professor Bancroft, I think, used the term “free bubble” in another sense, to represent the bubble after it has passed out of the surface of the liquid or when it was lying in the surface of the liquid. I use “free bubble” in the

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sense of a bubble not held, and I speak of this only that we may avoid confusion in reading the testimony. Prof. Bancroft was perfectly right in the use of "free bubble" as he uses it, but to make the distinction from the captive bubble which is held in a bubble holder, I will describe this as "free bubble." The bubble holders are of various forms. For handling a large particle it is more convenient to use a bubble holder of that form (showing bubble holder). For handling smaller particles a bubble holder of this form is used, and the bubbles are made by injecting air from a dropper into a liquid under the bubble holder, as illustrated by Prof. Taggart in his experiment. In this way we may determine quantitatively, although often roughly, but still quantitatively, the actions, forces and relations between the materials we have to consider. In the pulp we have air bubbles, water, mineral, gangue and oil, or a soluble frothing agent, and an electrolite acid or salt, and these are all present with agitation. We will see in some cases how they react. In order to save time in the handling of materials and cleaning up of vessels and so on, I want to present many of the things later as pictures, also partly because they are in more permanent form, and clearer than any description that I can give. The first question that we may ask ourselves is, does air alone lift mineral? We shall show, both by direct observation and in the pictures that it does. And how much 45 milligrams of a nearly cubical galena piece, which is far more of course than is necessary in practice; but it is a measure of the

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degree of attachment on which we can rely under certain conditions of cleanliness and length of attachment line. It is the measure of force on which we can rely to hold a bubble and a mineral particle together. One might infer that perfectly good flotation could be made in pure water. In practice, however, the mineral does not hold on to its bubbles. The question then arises, does the oil lift the mineral? We shall see that it lifts only very small pieces of mineral, less than a five milligram galena cube, with oleic acid and spindle oil, for instance, and that this attachment is weak and wobbly; that oil, if present in considerable quantity, tends to break up into globules, while, if the quantity is small, it tends to break up by pulling apart between the mineral and the air.

Whereupon an adjournment was had until 2:00 p. m. May 8, 1917.

2 p. m. May 8, 1917.

THE WITNESS: We were discussing the phenomena which occurred when oil, water, and mineral particles, etc., were brought in contact in various ways, and were planning to illustrate, first the direct attachment of air and mineral. In the first instance, we will use aluminum particles, because it is a little bit easier to observe what occurs with them, and because I have satisfied myself that they behave in a general way and to a large extent quantitatively just as do the particles of galena or other mineral.

In the first place we have there the small particles

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floating on the surface. If it is knocked down, it settles to the bottom, and if an air bubble is made in the bubble holder by the use of a dropper, similar to the one illustrated by Prof. Taggart, and the bubble is brought down in contact with the particle, the particle will be attached to the bubble and raised. (Illustrating) Now, on a large bubble we would have a nearly flat surface. It is possible, in the case of air, to raise the particle right through the surface and lift it out, still attached to the surface of the bubble. The particle in that case is in direct contact with the bubble, drawing the film of air down. That particle, probably, has in the extreme sense some impurity—grease, on the surface of it. Taking the successively heavier particles one after the other, if we cared to give the time to it and could give the time to it here, careful purifying of those, we would find that in each case the lifting was easier, the attachment was better in the case of the thoroughly purified particle; and as we reached the upper limit of what we could lift under normal conditions, which would be about the 54 milligram particle of this set, which I exhibited previously, we might be able to lift 69, but when we got higher than that we would find that it was very desirable, if not absolutely necessary, to take those particles out and give them a most thorough cleaning, and use pure matter, and to avoid any grease in the vessel. The 104 milligram particle I have lifted repeatedly, when I was working under conditions where I could have everything perfectly clean, carefully washed, and use distilled wa-

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ter—re-distilled water in fact, distilled the second time—and drawn from the lower portion of the vessel, so as to avoid any possible oil film that might have gathered on the upper surface of the liquid.

I want now to illustrate something corresponding perhaps to the overloading of the surface with sufficient of these particles have been placed side by side. They will ultimately draw together and break the surface down, but then as they stand now together in there, floating in contact with one another on the surface of the water, that illustrates what has been called the viscosity of the surface; and it seems to me that is somewhat stretching the use of the word "viscosity" because viscosity I think properly used does not imply any maximum of resistance to extremely slow movement or extremely weak forcing. These things are absolutely rigid, the one against the other, up to a certain small force, that they begin to acquire. In other words, a film of that kind behaves much more like a rigid body, up to very small limits, than does a truly viscous film. But I think anyone who has seen that phenomenon or who has examined the surface of the bubble coated with mineral particles will feel quite reconciled to an "armour coated bubble" or an "armour clad bubble". The lifting of these can be observed. At this time I may say that if any one cares to see the condition of the particles lifted that way and suspended in that way it can be done here. It makes no difference whether the particles are lying on the bottom and picked up by the air or whether we go

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down and pick them up. The net result is just the same. In some cases the particles may overlap a little; in some cases they may stand edge to edge. In this instance one of the particles which had not been knocked down to the bottom was picked up by the bubble, a large bubble about three quarters of an inch in diameter, which was already laden with six of the particles which had been hanging on the surface.

Q. 11. Describe what you have done?

A. I have taken a large sized bubble holder and brought it down upon the surface^o of the liquid at which were already floating six aluminum particles .012 inches in thickness, and weighing about 9 milligrams each, while there was also a similar particle lying at the bottom of the vessel. This descending bubble holder, however, caught the surface of the water and formed a bubble with it which carried down the six particles. The bubble was then carried down to the bottom and picked up the seven all attached to the bubble. Now, these particles, so far, have illustrated direct attachment to the air, as I call it, because the air is in direct contact with the particle, and it seems to me to prevent the extension or contact of the water with the particle. Large particles can be lifted in the same way and it is for the purpose of quantitatively examining the relative strength of attachment under different conditions that large particles are used. A 69 milligram particle is now placed upon the surface and floated with the others. It is knocked down to the bottom, and in order to get the comparable condition

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I want to have the smooth surface of the punching, so that I turn it over and place it on the bottom of the cell.

Q. 12. What surface now is uppermost?

A. The surface now is uppermost which was next to the bearing plate of the punch when the punching was made and which therefore is smooth and has its edges very slightly rounded, in contradistinction to the other surface which was roughened by the contact with the punching tool and has the edges slightly drawn into the minute interstices between the punch and the die.

Q. That is, so that there is a burr around the edge?

A. There is a slight burr all around the edge which would interfere with a comparison of the results and as we are working in the neighborhood of the upper range of lifting under these conditions, it might prevent the lifting of the particle. If the particle is clean it will lift; if not we will have to step down the line and take a smaller one. The particle is not clean, does not lift, and a peeling of the bubble away from the surface is of such a character as experience has taught me to recognize as the presence of a little grease. Experience has also shown me, however, that the presence of that grease in time can be offset, as I believe, by the distribution of the grease over the bubble so that when we are working at the limit by rubbing of the bubble even on the supposedly solid grease that is attached to the particle, we are able by this means to distribute the grease over the bubble

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and make a thinner layer on the particle so that now we can lift it, although somewhat precariously owing to the trembling of the hand. As we work with it the attachment would become strong and ultimately I think we can lift it quite reliably. At present it has been held up for five or six seconds in spite of the trembling of the hand which tends to shake the particle loose. Now, working as I say under extremely careful conditions to insure the purity of both the particle and the bubble, I have been able to carry the 104 milligram particle. If we take an amount of oil or grease of any kind which is what might be called tangible and apply to these particles we will find that the power of lifting, the strength of attachment is very much less indeed. And perhaps a striking illustration of that may be obtained with a very large particle if you choose to call it a particle. I have here an aluminum disc which is approximately an inch in diameter and weighs something over a gram. If a considerable degree of purity has been obtained I will be able to lift that particle. It has been washed once very carefully, and I think we may be able to raise it. When that particle has been raised, if we succeed in doing it (it is close to the limit) you will find that passing that lightly over any part of the body, (the hands, but particularly the nose), sufficiently greases the particle to carry it well below the lifting limit, and it will be impossible to raise it. In a similar way, particles which have had a small amount of oil applied to them, minute in any commercial sense, fail to lift when brought in contact with the air bubble.

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The reason for attempting to carry out this sort of lifting with varying sizes of particles and varying degrees of purity and varying amounts of oil is in order to examine quantitatively the effect produced by the different factors in different proportions as they enter into the fundamental operations of flotation. (Witness fails to lift the particle). The large particle is just on the limit of lifting, and I am afraid that needs another bath. This as shown emphasizes the extreme degree of purity it is necessary to use when we are working at the limits. That, by the way, is the particular piece used in raising the large aluminum disc in the picture that I plan to show later, and that was raised and lowered through the interface between oil and water, not merely to show the carrying power of the oil-water surface, which is far less than the air-water surface—but also to show the character of the necking out and pulling away of the oil, which we shall see clearly illustrated later. (Witness sends aluminum disc to be again washed).

I want also to show the action of the bubbles on the galena particles, and then the action of oil in considerable quantities as affecting the attachment of that galena particle to the air bubble. I have here a particle of galena, weighing 14 milligrams, and a glass cell having a false bottom of cloth, so as to prevent the sticking of the oil to the bottom of the cell. An oily particle coming in contact with the glass bottom of the cell is in danger, unless precautions are taken, of oiling the bottom of the cell and producing

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a cohesive action between the oil on the bottom of the cell and the oil on the particle, the result of which would be to retard, and possibly prevent entirely the lifting of the particle.

Placing the small sized bubble holder in the water, which occupies about half the height of the cell, and making a bubble in the holder, we first bring the bubble in contact with the clean particle of galena, weighing about 14 milligrams, and raise it from the bottom of the cell. It will be seen by rocking the cell and jarring the bubble holder that there is a considerable degree of attachment; that the particle is rather strongly held to the bubble holder and waves from side to side without being detached; if that particle is now oiled, we will observe a very different condition; we will pick it up again, and in order to avoid any jarring or vibration of my fingers I will allow it to be held by the clip so that it may be more carefully observed; the bubble holder is held by the clip, so that it can be really examined.

Now, removing the particle from the bubble and dropping it on the bottom of the cell—

Q. 14. MR. SCOTT: Will you remove the particle from the water and see whether it is wet or not?

A. Surely. Every opportunity that is given to the particle to pick up air on its surface and attach itself to the air will be welcomed by the face of the mineral. How would you like this removed, Mr. Scott? Of course if I take it up with a glass surface

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we have an entirely different set of conditions from taking it up with a metal surface.

Q. 15. Can you lift that particle up on the bubble?

A. I think not; I think it is rather too large to do that, but I will try to do so. I will try it, but my impression is that it is above the limit which, for these conditions, will permit the lifting through the surface. If, however, I had a surface surmounted or covered by other bubbles, so that the supply of liquid was ample, this particle could come up on one bubble and float up through a series of bubbles. That is an occurrence which it is a little difficult or practically impossible to perform under these conditions. In order to avoid the breaking down of the bubble surface in the pure water, to which Professors Beach, Taggart and Bancroft have testified, and it is perfectly correct—I must change the condition and will have to supply a layer of liquid in which it may lift, so I will have to make my bubble somewhat smaller—~~also there is~~ *th!* your particle carried through the surface on the bubble and hanging to the face of the bubble in a film—(witness to Prof Beach) The gentleman is now yours; he has fallen off on your hand.

Q. 16. MR. SCOTT: Did you observe whether the particle was wet?

A. It is still wet in parts, and it is also dry in other spots where the water has retreated from the surface.

Q. 17. Is it wet underneath?

A. Oh, yes, it is wet underneath, because, hang-

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ing under the bubble, there was a layer of water in which the particle was suspended by direct attachment with the bubble.

Q. 18. THE COURT: When it lay in the bottom of the vessel wasn't it wet?

A. It was then thoroughly wet. I never have been able to detect with any certainty a layer of air on the particle. Very frequently a particle falling in that way through the liquid, will carry down a bubble with it, attached to a portion of the surface, but I think careful observation of that will indicate that there is no layer of air.

Q. 19. THE COURT: If you scientific gentlemen can not see it—

A. Either through our eyes or our imagination? (Laughter.)

I think it will be found that there is no visible air on the surface of that particle. It is true that when that particle is allowed to stand in the water for some time, and observed with a microscope, there are very frequently collections of air on points; but, taken as a whole, I have never found the particles otherwise than wet when under water.

Now, if we leave that particle on the bottom and apply to it a small amount of oleic acid or pine oil or kerosene or any other oil with which I have experimented, we find that under the conditions here of substantial wetness over the whole surface of the particle, the oil does not spread beyond a certain point. Dr. Taggart's diagram of his experiments when oil was

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dropped through the surface of the water to the upper surface of the mineral, very accurately represents the condition, and the oil gathered as a dome on the portion of the particle to which it is applied. Of course with agitation that can be spread all over the surface. I will try to apply a small quantity of oil to the surface of the particle, making the amount as small as possible. In doing so, of course we contaminate the surface of the water, flashing an oil film over that surface the minute we touch the oily dropper to the surface.

Q. 20. MR. SCOTT: What kind of oil is that, Doctor?

A. I am using oleic acid. I have done the same thing with kerosene and pine oil and some 8 or 10 different oils that I can not remember just now. After the particle has been under the water for a little time it is somewhat difficult to get the oil to attach to the particle, without actually rubbing it on. Furthermore, the surface of the dropper being oily, the oil prefers to travel up the dropper, rather than seek a new path to the mineral, but with a little persistence it is almost always possible to apply the oil directly to the surface of the particle and leave a dome of oil attached to the mineral, as the mineral lies on the bottom of the cell. A small bubble of air is observed in this cell, to have come out of the dropper with the oil, and to be entrapped in the oil, but not to be in contact with the galena. If, now, we undertake to take that particle up with a bubble, we will

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observe the necking out or necking off of the oil, which has been described by Prof. Bancroft. I ~~could~~^{should} estimate the amount of oil on the particle to be, perhaps one-fifth to one-tenth—somewhere around that, of the total volume of the particle.

The surface of the water I note has several oil globules on it. These demonstrate the condition described in the diagram this morning of a minute film of oil covering the surface of the water and stable at a minute thickness against the presence of oil lenses which are floating at the surface. In going down for a particle I will blow upon the side of the water endeavoring to force away that minute film so as to get below the surface with the least amount of oil which I can. Generally, by blowing on the surface that way, the film can be forced aside so completely that the bubble holder which has been entered below the liquid does not carry with it any film of oil. In the same way, for the same reason I will bubble the air out of the dropper before I make the bubble, so as to remove^{as} far as possible any oil from the equation except the oil present on the particle itself. Of course that really doesn't matter very much because there is so much oil on the particle, but what I want to illustrate is the action of a substantially clean bubble in the bubble holder, taking such precautions to avoid the presence of oil on the surface of the bubble, and we will lower the bubble as gradually as possible until it apparently makes contact with the oil without bringing it any closer than that. At a certain point it

P. 4190, L. 27, insert "and an evenly oiled particle; We have now made the bubble" before "in"

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seemed to me that there was a slight deformation of the bubble before contact was actually made. In the picture that I hope to show you later there will be seen quite clearly the bumping side of the oil globule by the air bubble, due in all probability to the minute film which is formed on the surface of the oil in the water and the minute film which is formed on the surface of the bubble in the water. Your honor will observe that once the contact has actually been made between the particle and the air bubble, the oil stretches out as a neck. I might observe likewise, a certain change in the appearance of the bubble, a little larger just at the instant of contact, which was due to the sudden spreading of this minute film of oil over the surface of the entire bubble; and, if we could overflow this liquid so as to carry all oil away from it, and enlarge the bubble, and withdraw the glass we would find that the surface of the glass where the bubble joined it was slightly contaminated with oil, showing the presence of that film over the surface. Now, going down, as we have, coming in contact with the particle and slightly moving the dropper and the bubble to one side, we observe the under surface of the bubble (in addition to this layer which we cannot see because it has now finished its flash and is so minute that we can only observe it by a change of reflection on the bubble), in addition to that layer which we know is there, which we can prove in many ways is there, we have a minute globule of oil which is dangling on the bottom of the bubble. Another illus-

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tration of contact with a film. Going down on the surface of the oil and this time going down substantially so as to make a good contact, and not make the oil reach out, and now slightly raising the bubble, we see again clearly the drawing together of the oil upon the surface of the particle and the surface of the bubble into a neck which, as we gradually raise the bubble, draw out and breaks. Now, if we select a portion of this surface and clean it of all visible oil globules and tip the bubble holder up so that the bubble rises to the surface and breaks, and examine the surface, we find a minute particle of oil lifted there by the bubble. Can your honor see it right at that point, see the little particle of oil floating on the surface?

THE COURT: About five of them there.

A. They are very apt to break up and separate and very possibly some of these may have been lifted from the other bubbles. But, repeatedly, I have insured the absence of such residual oil by sweeping the surface over the top of the glass, flowing clean water in at the bottom, and then taken one bubble and seen the particle of oil raised by that bubble. A further indication of the removal of oil by the bubble can be had by making the bubble over again, repeating it rapidly, and notice the clear decrease in the amount of oil each time. Each time the bubble is brought in contact with the particle it similarly draws out a little bit of oil which breaks off with the weight of the particle as it is doing now, and carries away with the bubble a decreasing amount of oil. The bubble can be raised

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to the surface again and again and will ultimately carry nearly all the oil away from that particle. It takes a great deal of time to carry quite all of it, but it can be done. It is easier to do it evenly with a stream of air bubbles than with a succession of individual bubbles. Therefore—

MR. WILLIAMS: Q.21. Now, state what you are doing?

A. We have now a small tube from which air is issuing in bubbles, underneath the surface of the water, and we bring these bubbles, one after another, in contact with the surface of the oiled mineral. And as the bubbles pass, one after another, knowing as we do that each bubble takes a little oil, we are not surprised to observe that the particle begins to show activity and jumps towards the outlet of the air. Passing the bubbles slowly in that way it takes a great deal of time to remove the last traces of the oil in the case of oleic acid from the mineral. By more rapidly bubbling, the oil is removed, one portion after another, and as the particle is scoured and washed with air we gradually reach a condition where the particle is capable of attaching itself directly to the moving bubble and rising to the surface. Whether that will happen in this particular instance in the time we have to give to it I do not know. Apparently cracks in the mineral and different characters of surface of the mineral have a great effect on the length of time that it takes for the air to de-oil the mineral. The mineral particle hopped perhaps a sixteenth of an inch off the bottom, then, under the action of the bubble so that I am

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led to hope that this may give us the desired result without too great an expenditure of time. The particle is becoming more and more active but does not yet seem to be cleaned up. Now the amount of oil or impurity that is required to produce that blanketing action I know to be minute. The exact amount is extremely difficult to ascertain because as I stated the character of the surface, the kind of oil, the position of the particle, the shape of the particle all effect that precise limit, if it be precise; and it is generally so small that we cannot follow the effects of these different factors. It jumps. The movement is so quick that it is very difficult to follow. I have had them to go to the surface a great many times and come down when I didn't quite know it, just see the difference in the position on the bottom. If the particles are very large however and unless the bubble happens to be a large one the movement is generally slow enough that it can be observed. It sometimes takes a very long time to remove the oleic acid completely enough to get a result.

Witness takes up aluminum disk sent to be
~~remarked~~ *washed*

We will temporarily leave the air bubbling over the particle and return to the large aluminum particle which was previously too much contaminated to lift. One reason for the failure to lift a large particle of this kind under these conditions is quite frequently attachment of the particle apparently to the bottom of the

P. 4195, L. 23, insert ", you notice the water on the upper surface " after " surface "

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vessel as it can be observed in this case by the fact that it is hard to turn it over. We will therefore support this disc a little away from the bottom of the vessel on a couple of small aluminum pieces, when we try to repeat the operation. The manipulating difficulties of the work are considerable and it is for that reason that I preferred to save as much time in showing a varied range of experiments as possible by recording the results in the form of pictures. In spite of these difficulties, however, after a considerable range of experiments it becomes quite clear that the general phenomena are perfectly reliable and the quantitative results are entirely reliable if not always absolutely concordant. The way in which the water withdraws or fails to withdraw from the surface of the particle frequently indicates the degree of cleanliness, and in this case also I find that the particle is not entirely clean. You will observe that the large aluminum disc has been lifted clear off the bottom hanging in the inner surface of the bubble. Now, referring to the question of wetness or non-wetness of that surface of the aluminum particle right inside of the bubble. That is quite a layer of water lying on the upper surface and including—do you see the little globes of water lying on the surface of the particle.

THE COURT: Yes, I see them.

A. That is an evidence of more or less irregularity and impurity of surface and it is that increased weight which makes it difficult to lift.

THE COURT: You mean a little collection of water?

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A. Yes.

THE COURT: Is there a text book on bubbles?

A. I know of only one book on bubbles that is perhaps authentic and that is Rayleigh's work on foam. Bubbles in this connection I don't think have been written up by what might be called any authorities. A great many papers have been written, general articles, and a very considerable portion of the work is quite accurate if we stick to the statement of facts and do not attempt to draw conclusions as applied to this or that phase of some litigation.

THE COURT: I was just thinking, taking the testimony on both sides, you might write up a text book.

THE WITNESS: I believe we could make a very interesting and valuable text book, judging from the testimony which I have read because a very great portion of that testimony is, scientifically, thoroughly accurate and reliable.

MR. SHERIDAN: There is a small book, isn't there, professor, on soap bubbles?

A. Yes, but I was thinking more of bubbles in this relation.

MR. SHERIDAN: That is actually a very interesting book.

A. Very interesting, indeed. Now, the question will arise: what is the action of air on mineral in the presence of oil in quantity? The answer to that may perhaps be given by taking a little fine mesh galena (which by the way is merely mineral as 200 mesh

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and has all the dust in it, running down to I don't know how fine), and placing some of that at the bottom of a watercell. One thing will be noted and that is that the air in that mineral has formed what might be called a bubble filled with galena, that it sticks to the metal, to the forceps and does not come off, held in by the film around its surface. Now, if we knock some of that down to the bottom of cell and get enough down there to be sure of our having minute particles on the bottom, then if we put a layer of oil above it and we have already made a bubble of air under the bubble holder in the water beneath the layer of oil, we will be in a position to examine as we raise that bubble, the effect of the air on the mineral in the presence of excess oil.

Q. 22. MR. SCOTT: Are you putting an oil layer on top on this experiment?

A. Yes.

Q. 23. On top of the water?

A. Yes. We now have a vessel half filled with water on the surface of which some galena particles are floating.

We have placed the bubble holder on a rest within the water, with the cup beneath the surface of the water. We have formed a bubble of air in the holder. If now we pour oil on the surface of the liquid we will have an uncontaminated bubble, at least if the oil is insoluble in the water, with the oil above it.

Q. 24. MR. SCOTT: Is there any oil on the bubble now, doctor?

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A. At present, as far as I know, there is no oil upon the bubble. It was not made with any extreme precautions, but there is no substantial amount of oil. as far as I know.

Q. 25. No oil was put in there?

A. No oil was put in there. If there was any oil, it was the atmospheric, condensed oil film which Dr. Bancroft told us about.

On the surface of the water I now pour a layer of kerosene, and it will be seen that the aluminum particles and the galena particles float in that interface. That is one way of putting it. Another way of putting it is that we have now an atmosphere of oil on top of water, and we have an interface between the water and that atmosphere of oil, which has a certain surface tension. The size of the particles is such that they are incapable of breaking that surface tension. If the particles of galena are materially larger than 5 milligrams, they would not have stayed up there. If the particles of aluminum were materially larger than 27 milligrams they would not have stayed up there. In illustration of the last statement I will try a 27 milligram aluminum particle, and since it is on the line where the phenomena are dependent on microscopic conditions—it may go either way. I think from experience that this particular gentleman will pass through the oil layer and pass on down into the water. I have tried as far as possible not to let any unsteadiness of my hand—Oh, he has stayed there on the interfacial layer. Now, if we take a larger particle—Just how

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far the limit will go with this kerosene I can not say, because the surface ~~of~~^{of} the interfacial tension between kerosene and water is considerably higher—with oleic acid this 28 milligram particle goes through. With kerosene the value would be probably considerably higher than that. However, before seeking that limit, we will apply the bubble which we have formed in the water to some of the fine mineral at the bottom of the cell, and you will see that the bubble has picked up the finely divided mineral from the bottom, leaving in the first place a cleared disc at the bottom, and in the second place lifting the particles hanging on the bubble.

We now raise the bubble to the interface and seek to learn whether the attachment of the mineral to the air will be interfered with by the presence of the oil. I have, I think, raised the bubble to the point where the interface between the oil and water has just reached the edge of the bubble, where it joined the glass, and in raising that bubble slightly higher we draw out that interface. Now, we have raised the bubble to the point where it passes through that interface, and the interface can be seen to have swept off the mineral which was attached to the bubble, with the exception of a minute particle of water which was caught up and mixed with the oil. It will be seen that the bottom of the bubble is clear from the black mineral, and the black mineral is now hanging at the interface. This state of things particularly illustrated here, is illustrated in another way by placing the min-

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eral originally in oil, and going down with an air bubble in the effort to pick up the mineral surrounded ^{with} oil. (Witness puts bubble holder down again.)

There are still some particles of mineral floating at the ^{oil-water} surface, and it will be noted that the air bubble is capable of carrying those particles down, attached to the film of oil which constitutes a portion of this bubble when it passes from the oil down into the water. If we raise the bubble into the oil and attempt to carry these particles from the interface up into the oil, we find that in the oil there is no attachment between the air bubble and the mineral.

Now, I have repeated that many times with mineral of the finest mesh that I could get, and the air bubble remains clean, as you now see it.

These methods are given, not as examples of flotation commercially, but as visible statements of the principles which must control in the inter-action between oil and air and mineral, as they are present in the pulp. Precisely the same kind of experiments can be carried out, in which I take modified water, that is, water in which there was dispersed—separated throughout the water—a portion of oil of soluble frothing agent. Now, the continued bubbling of the air over the particle in the water cell has removed the oil, not once, but a number of times, and the particle has jumped to the surface, picked up oil from the surface, and gone down, carrying, as I have seen it many times in the pictures, and hope to be able to show it in one of the pictures—carrying a considerable dome of oil

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with it when it returned to the bottom. The dome of oil is not on it now, but that is ~~this~~^{the} way he goes up and gets oil and goes down again. There is no oil on there now; it has been cleaned off by the air bubble. When I say no oil, I mean substantially no oil. This particle is just at the limit of lifting with any considerable quantity of oleic acid, and there may be oleic acid disseminated throughout the liquid, so that it may account for the change from quick lifting—There, it went to the surface and dropped clear back of the bubbling tube. The smaller particles lift more readily, and it is found that, whereas a clean air bubble in unmodified water—There it is, fortunately hanging at the surface long enough to be observed before it came down again.

Referring to the experiments carried out with modified water, in the sense of water containing a soluble frothing agent which we know is dispersed throughout the water and is in position to act at the surface of the bubbles, we find that the attachment of the particle to the bubble in the sense of the weight of the galena cube that the air bubble will pick up, is very much decreased as compared with the weight of the particle which the same air bubble will pick up in perfectly pure water. We find, likewise, that using the captive bubble, in the sense of a bubble held in the bubble holder, a very much larger particle can be picked up than will be taken up by the free, moving bubble, as we would expect; the difference is something like two to one; that is, the free moving bubble

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will lift only about half as large a particle as the captive bubble. The difference between the modified water and the unmodified water is not so great, being in the ratio of something like 60 to 100. In that way, using different sets of conditions and different oils and different soluble agents, different mineral particles, it is possible to establish perfectly certain relations between the strength of attachment under any given set of conditions, and the attachment under another set of conditions. While these results may not be accurate in the sense of precise to a decimal place, their range is extremely accurate and reliable, and in this way we are enabled to answer the questions which arise, or to make the physical material themselves answer for us the questions which arise in considering flotation.

Among those questions, we have spoken of the question whether air bubbles attach directly, and have seen that in the common sense use of the word direct, they certainly do, if the mineral is clean. We have likewise seen, in the common sense use of the word "direct attachment," that the mineral particle which jumped on the bubble to the surface attached to the bubble, was directly attached to that bubble. There was the surface of the bubble coming down into immediate contact with the surface of the particle. That can be very much better observed in the picture, of course, than it can be in the fleeting movement of the particle, observed by the eye.

We have asked the similar question, whether oil

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lifts mineral, and find the answer that it does very little, and by taking a series of particles and carrying them out quantitatively we learn that less than 5 milligrams galena cube will be picked up by oleic acid or spindle oil, and that that varies in that general range with the different kinds of oil. We learn also that that lift is somewhat precarious when it does occur, owing to the fact that when the particle even is not heavy enough to break off the oil neck, the sweep of any current of water over that oil neck would likewise tend to destroy it. We have learned that a bubble of air surrounded with plenty of oil does not hold the mineral to it; that the mineral moves away from the bubble, in preference going to the interface on the other side of the oil—the water—oil interface. Under those conditions, with the bubble in oil and the mineral in oil, we can be reasonably sure that it does not lift even .005 of a milligram.

The question arises how little oil will cut the lifting power and produce this weak oil neck, and an examination of the phenomena has indicated that that occurs about the point when there is enough oil to come between the particle and the bubble, and about the same amount of oil which would cause that particle to adhere to a solid material through oil adhesion, if the bubble were a solid ball of metal, instead of a globe of air.

The question arises, what does the oil do, and I have found that it affects the air and the water, rather, perhaps, than the mineral; at least the effect on the

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air and water is the most radical and observable effect, in the sense that it produces more persistent bubbles and more gradual joining of bubbles, which is called coalescence. In the same way, taking small amounts of the material in hand, and subjecting them to precise controlled conditions, we find that, as a general rule, the soluble frothing agents have a very great effect on this character of the bubbles under the water, the way they are formed and the way they unite or fail to unite. In ~~this~~^{these} ways I have reached certain conclusions regarding air froth flotation. They were reached from observation, and most of them are the mere statements of observed fact.

Air flotation depends upon these following facts, most of which have been stated in substance by one or the other or all of the scientific experts testifying for the defense. Practically all of these facts can be seen photographically recorded and projected on the screen. They are:

First, a clean air bubble in water, whether captive or free, in the sense of free rising, in unmodified water will attach and carry mineral particles of a weight roughly corresponding to the surface tension at the air-water surface, acting upon the line of the attachment of the bubble surface to the mineral. This power of attachment, measured by the gentle application of lifting, is about ~ 40 milligram galena cube. In the ordinary sense, the attachment is direct to the bubble. One might say directly to the air.

Second, in pure water, however, air bubbles coal-

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esce with a suddenness and violence which generally detaches the mineral particles. This suddenness approaches $1/12,000$ of a second.

Third, an oily mineral frothing agent can be made to coat mineral particles. It can be shown, as we had opportunity to observe it there, to quickly flash a film of infinitesimal thickness, about $4/100,000,000$ of an inch, over the surface of the bubbles. The figure, to be more accurate, is 4.16; and while it may seem absurd to measure a figure of that size in one or two decimal figures, the work of De Veaux indicates to me that he has determined it within an accuracy of 10%. That is his opinion, and the methods he used are so simple and direct, that I see no reason why it should not be true. That this film increases slowly to about twice this thickness over the air-water surface. Thus modified or contaminated, the air-water surface tension is reduced to a moderate extent, varying with the character of the oil and the temperature; but after a certain minute quantity of oil is present, possibly $1/1,000,000$ or $2/1,000,000$ of an inch, further change in the surface tension is relatively small. The power of attachment of the bubble to the mineral varies, as we have seen, with the amount and kind of oil, but in general range of a 30 milligram galena cube. In this case the attachment is direct to the bubble as a whole, and possibly there is also attraction through the oil film to the air, as explained this morning.

Fourth, the presence of an oily mineral frothing agent in the bubble or in the water also modifies the

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water in the sense that the subdivision of the air is rendered easier and coalescence of bubbles is retarded, reduced or entirely prevented.

Fifth, a soluble mineral frothing agent probably coats a mineral particle and a bubble of air in a different manner. It certainly does modify the water, in the sense that has been given in No. 4. Usually the soluble mineral frothing agent does this to a far greater extent than the oil. The power of attachment is also reduced with the soluble frothing agent to about a 30 milligram galena cube. In this case the attachment is direct to the bubble, if not directly to the air.

Sixth, the oil film of Nos. 3 and 4, possibly also the adsorbed films of No. 5, promote or facilitate the quick attachment of the mineral to the bubbles, even though such films have reduced or modified the power of attachment to the bubble. Accompanied by electrolytes—acids, alkali and salts,—in the pulp, these films give a controlled affinity of air bubbles for the metallic particles in the presence of a frothing agent, and if given opportunity, produce a stable froth of the so-called armored bubbles.

Seventh, the addition beyond this minute quantity of oil produces an excess of oil; whether it is added to the mineral or to the bubble, provided they are in contact. If there is enough of it, it will collect on the surface in the form of lenses or globules, thickening the film, and thereby separating the modified contaminated or double surface to a visible extent. When sufficient excess oil is thus added we reach the upper

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limit of the oil quantity, which is capable of producing the effect of direct attachment, an effect obtained with a minute quantity of oil. Beyond that point the mineral, or even the oil alone is liable, in agitation, to be swept off a bubble and carried away. Under the conditions last described the mineral no longer directly attaches to the bubble, and that leads to a distinction between an oil froth and an air froth. I will describe an oil froth as an aggregated mass of globules and films of oil and water, with bubbles of air, having the mineral contained in the oil, and from this froth the air bubbles are likely to slip away because of their ability to move through the oil upwards; and the mineral is likely to slip away downwards through the oil and through the oil-water interface, and drag masses of oil with it. The power of attachment of the oil globules in the water for mineral (making the oil globules, just as we made an air bubble by allowing oil to rise up under a bubble holder) is often less than 5 milligrams of galena cube.

~~THE WITNESS:~~ ^{eight} With No. 8 with amounts of oil such as we were speaking of that visibly separate the air-oil film on the inside from the oil-water film from the outside, the mineral particles if small are free to move around each other, to gather in masses at one or the other side of the oil mass that is surrounding the bubble and produce a heavier drag on the weak oil link or oil neck which now alone attached^s them indirectly to the bubble.

9th. Some oils are non-frothing, kerosene for ex-

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ample, and are substantially inert so far as No. 4 is concerned (the modification of the interaction of air bubbles and water by the presence of the oily mineral frothing agent). Some of these, among them kerosene, are less detrimental in respect to No. 7 (the effect of further addition of oil beyond the minute quantity) ^{and} ~~on~~ No. 8 (the readiness with which particles gather in sufficient amounts to tear off the oil neck). Violent agitation tends to emulsify some of these oils, among them kerosene, so that they may be carried in the circuit water to be entrapped in the settling concentrate of the gangue slimes. Air bubbles which may be produced in great quantity by unnecessary agitation can ~~de~~ oil mineral particles and uselessly add to the quantity of the froth. Great violence of agitation subdivides the oil globules and makes them smaller so that original overloading of bubbles with mineral particles is reduced or retarded and more useless oil can be put through the system.

Tenth. It appears throughout the above that mineral frothing agents are not of necessity oils or oily in character, so that it is a mere incident that oils are also some of them mineral frothing agents if used only in such minute quantities that they no longer act like oils in bulk, and do not show the properties that are exhibited in the oil froths. Also that what I have called an oil froth is indeed radically different from an air froth. While it may be difficult, if not impossible, to draw a sharp line during the transition stage, particularly where an excess of inert oil is added and agi-

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tation and aeration increased, the technical effect changes somewhere, dependent upon conditions until finally all traces of air froth have been made to disappear.

Q. 26. I call your attention to the testimony of Professor Beach wherein he is considering the action of a captive bubble or a bubble in a bubble holder and wherein we find the following, 128-Q. "Now what would happen if the bubble holder were lifted upwards—" it was the case of clean sulphide mineral—"A. The force of surface tension has a certain component. If the particles of sulphide were greater than the total value of the upward pull of surface tension, it would not be lifted from the bottom, but the bubble would stretch out and would finally neck off and we should have a complete spherical bubble attached to the bubble holder, and probably a little watch glass bubble attached to the surface in case the sulphide was too heavy. If the sulphide particle was not, then I should expect that the bubble would lift to the surface through the water." What have you to say on that testimony?

A. This is a substantial confirmation of statement No. 1 that a clean air bubble in water, captive, in unmodified water will attach and carry mineral particles to the surface, particles of a weight roughly corresponding to the surface tension of the air-water surface acting around the line of attachment of the bubble to the particle. Beyond that, it is a demonstration of theorizing as to what will happen which my

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own observation does not confirm, because while the bubble may split and a portion of the bubble remain with the particle, I have not seen a watch glass shaped residue of air left on the particle; and the almost invariable action is that the whole bubble peels away from the particle precisely as we saw it a number of times in the experiments just shown.

Q. 27. Professor Beach, in his testimony, described experiments with an aluminum ring floating upon the surface of the water and carrying considerable weight when clean and failing to carry that weight when slightly oiled, in answer to question 109, his description having been given at some length. Have you anything to say as to that?

A. That similarly confirms the general statement above quoted from conclusion No. 1 and further has an application where he applied oily material to it, in confirmation of some of the later statements.

Q. 28. I call your attention to the answer of Professor Bancroft in answer to Q. 132 which I will hand to you without reading in the record and ask you what you have to comment upon that testimony?

A. With the statement that so-called minerals, zinc sulphide and lead sulphide, do generally adsorb air markedly, I am not at all disposed to disagree. It confirms clearly the statement that finishes my statement No. 1 as to the direct attachment of minerals to the bubble if not directly to the air. I think it is possible for just some such reason that the mineral is not readily wetted by water and Professor Beach says

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that there is no reason why we should not have direct connection between the air and the mineral; that he would not think of disputing it.

Q. 29. And when you have finished with that I will ask you to include also the following question, ~~132~~, 133 and the answer, for your comment?

A. Continuing with 132 it is of course true that we may not have direct contact between the air and the mineral. We have seen that under certain circumstances we do not. But, insofar as he means that there can be no influence of the air on the mineral through a minute film of oil, I cannot agree with him because there is every indication that there might be and at the same time I do not know that there is. With regard to question 133 where mineral particles are apparently lifted by air, is it certain that that is really happening? It is true of course that if the mineral particles are sufficiently dirtied or covered over with oil, it is not true. My experience indicates that if that is the case, the attachment of the mineral to the bubble is extremely small, that the intermediate stage of reduction of the thickness of that impurity coming between the air and the bubble when it reaches a minute amount, the mineral particle is in position as indicated in diagram No. 2, where both surfaces ~~or~~ interfaces (the interface between the air and the oil and the interface between the oil and the water), are in position to act upon it and attach it very much more firmly to the bubble. The mineral particles that I have handled in determining the limits of these at-

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tachments have been carefully either preserved in their original cleanliness or cleaned, because experience quickly taught me that any reliable results necessitated that. Where we have used the aluminum particles, some precaution had to be taken if we desired to have a clean particle. The galena particles, where extreme precision was required, had to be as I say very carefully cleaned, and we identified—checked up the results by breaking galena under water in order to insure the absence of false films of impurities that might have come down upon the galena or been attached to it in handling or in some other way. So that I agree with him thoroughly that it would depend on the degree of care with which the experiment was carried out. And his testimony there agrees entirely with our conclusion.

Q. 30. Professor Beach has testified in answer to question 254 as follows: "If this oil was kerosene or creosote or pine oil at the instant of contact of the oil point with the surface there is usually seen a flash of oil over the surface—seen by reflected light—you get the colors of the different films; the experiment is readily visible in that form." What have you to say as to that?

A. It confirms the first part of what has been stated above as conclusion 3, that the oily mineral frothing agent can be made to flash quickly, be shown to flash quickly, a film of infinitesimal thickness over the surface of the bubble; and anyone used to observing bubbles can see that same film flash over the